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Launching a Legal Regime: Applying Constitutional Law to Space Law

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This Article analyzes the applicability of constitutional law to rules governing outer-space behavior. By analyzing the uses of text, history, and practice in the interpretation of the United States Constitution and space agreements, I conclude that living constitutionalism provides the best template for interpreting space law. Its method of reading texts to fit modern society aligns with the New Haven School of International Law's realist focus on values such as equity and human dignity. Beyond interpretation, constitutional law may be particularly informative for rule promulgation. It provides examples of how leveraging John Rawls's veil of ignorance can enable the creation of rules less tainted by self-interest. This principle can apply to space-law issues such as property rights, debris, and militarization. However, there exist strict limits on applying constitutional law to space law. Constitutional law and international law operate with fundamentally different governance structures. Thus, suggestions that the Outer Space Treaty of 1967 (O.S.T.) is tantamount to a "Space Constitution" reflect an insufficient understanding of the fields' differences. Still, the O.S.T. is akin to a constitutional preamble that outlines guiding principles and invites us to continue shaping new rules for the global space order we desire.

Keywords: Outer Space Treaty of 1967, U.S. Constitution, Living Constitutionalism, Veil of Ignorance, Property Rights, Space Debris, Space Militarization, Preamble.

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Introduction

In accepting the Democratic nomination for President of the United States, then-Senator John F. Kennedy declared in July 1960 that the nation was "on the edge of a New Frontier...a frontier of unknown opportunities and perils – a frontier of unfulfilled hopes and threats" (Kennedy, 1960). Two years later, now-President Kennedy announced the nation's intent to land on the Moon by the end of the decade, proclaiming that outer space exploration would

be “one of the great adventures of all time” (Kennedy, 1962). Kennedy’s aspirations still resonate today in the possibilities that new technological developments have opened for space. We already rely on satellites for navigation, communication, financial operations, weather tracking, and national security (Rose, 2019; Hobe, 2019: 17-27); companies are exploring space resource extraction (von der Dunk, 2017: 83-84; Hasin, 2020: 79); and the Artemis missions of the U.S. National Aeronautics and Space Administration aim to “land the first woman and first person of color on the Moon” and first humans on Mars, as well as “establish the first long-term presence on the Moon” (NASA, n.d.).

While technological possibilities capture the public’s imagination, the legal framework undergirding space exploration is just as critical. Given the dearth of regulations applying to current and future space activities, many scholars have consulted existing legal regimes – most notably, the Law of the Sea (Hasin, 2020: 135-48; Leepeungham, 2017: 32-55). This Article offers an additional field for comparison: constitutional law. While constitutional law and space law have areas of overlap – especially as to crafting rules – the evolving and international nature of space law requires cautiously applying constitutional law.

Part II focuses on different methodologies of legal interpretation. An analysis of text, history, and practice as interpretive tools demonstrates how living constitutionalism is the most analogous constitutional-interpretation method for space law. Indeed, living constitutionalism strongly resembles the New Haven School of International Law, the ideas of which Gershon Hasin applies to issues in space law. Part III discusses how constitutional scholars’ invocation of John Rawls’s “veil of ignorance” can also apply to the promulgation of rules for space in areas such as resources, debris, and militarization (Rawls, 1999).

The next two Parts focus on the limits of applying constitutional law to space law. Part IV highlights how the fundamentally different governing structures in domestic law and international law – especially relating to the enforcement of legal instruments – compel extreme caution when using constitutional law in space law. Thus, Part V concludes that those who consider the Outer Space Treaty of 1967 (O.S.T.) to be a “Space Constitution” fundamentally misunderstand both what a constitution is and the rules needed for the constantly evolving realm of space.

Interpretation

American constitutional scholar Philip Bobbitt has famously categorized and described six types of constitutional arguments (Bobbitt, 1984: 3-119). Given that both constitutional law and space law involve understanding legal instruments, interpretation is a fitting focus to begin comparing the two fields. This Part focuses on three methodologies – text, history, and practice – before concluding that living constitutionalism presents the best constitutional philosophy for space-law interpretation.

a. TEXT

Bobbitt opens his discussion of textual arguments by quoting the brilliant nineteenth-century justice Joseph Story’s remarks: “It is obvious, that there can be no security to the people in any constitution of government if they are not to judge of it by the fair meaning of the words of the text” (25). In oft-cited 2015 comments, Justice Elena Kagan noted that “we’re all textualists now” (Harvard Law School, 2015). Despite the ostensibly simple proposition of just following the text, there is frequent disagreement over the right level of literalism, the usage of

historical dictionaries, and tools such as corpus linguistics. Nevertheless, overlap exists between constitutional interpretation and that for treaties governing space behavior like the O.S.T.

In international law, the Vienna Convention on the Law of Treaties (VCLT) informs textual interpretation. Specifically, Article 31 provides that “[a] treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose” (Vienna Convention, 1969). This language resembles the most popular originalist approach to constitutional interpretation today, as Lawrence B. Solum summarizes:

The Public Meaning Thesis is the claim that the original meaning of the constitutional text is best understood as its *public meaning*: roughly, the meaning that the text had for competent speakers of American English at the time each provision of the text was framed and ratified (Solum, 2021: 1957).

Just as the VCLT discusses the “ordinary meaning” of language, Solum focuses on how “competent speakers of American English” would interpret language. Emphasizing “ordinary meaning” for the U.S. Constitution is especially appropriate because it derives legitimacy from “We the People” who ratified it, not legal wordsmiths (U.S. Constitution: pmb.). Note also that the focus on a treaty’s “context” parallels Solum’s emphasis on the meaning of the text “at the time each provision of the text was framed and ratified.”

True, some originalists focus on the Framers’ intent (Solum, 2021: 1965). This methodology is inconsistent with Article 32 of the VCLT, which only permits consultation of the “preparatory work of the treaty and the circumstances of its conclusion” when a textual interpretation yields an “ambiguous or obscure meaning” or a “manifestly absurd or unreasonable” conclusion (Vienna Convention, 1969). Yet Solum’s “Public Meaning Thesis” is the “prevailing form” of originalism today, and it is consistent with the VCLT (Mazzone and Tecimer, 2022: 332 n.9).

Both constitutional and treaty interpretation also involve the consultation of external documents. Yet such citations must be done cautiously to ensure that the external text really glosses the one in question. Article 31 of the VCLT provides specific criteria for when an external text may be relevant:

2. The context for the purpose of the interpretation of a treaty shall comprise, in addition to the text, including its preamble and annexes:

- (a) Any agreement relating to the treaty which was made between all the parties in connection with the conclusion of the treaty;
- (b) Any instrument which was made by one or more parties in connection with the conclusion of the treaty and accepted by the other parties as an instrument related to the treaty (Vienna Convention, 1969).

In U.S. constitutional law, it is common to consult external documents. Consider, for example, the Civil Rights Act of 1866, which scholars regularly cite to understand the Fourteenth Amendment (Amar, 1998: 169). Such a reference seems consistent with the principles of subsection (a) above, given that the same party that drafted the Act – the 39th U.S. Congress – also drafted the Amendment.

However, both constitutional and international lawyers can become overzealous in consulting external sources. Steven Gow Calabresi, Bradley G. Silverman, and Joshua Braver, for example, criticized Justice Stephen Breyer’s citation of Germany’s, Switzerland’s, and the

European Union's federal systems in *Printz v. U.S.*, 521 U.S. 898, 976-78 (1997) (Breyer, J., dissenting). Pointing to differences between those federal systems and that of the U.S., Calabresi et al. argued that Breyer was "guilty here of a textbook example of the faulty use of comparative constitutionalism" because he was trying "to draw lessons...from the constitutional structures of three fundamentally different regimes" (Calabresi et al., 2016: 70).

Space-law scholars are not immune from making such mistakes. As Hasin explains, "a misguided fixation on the Law of the Sea as a framework leads scholars to propose comprehensive regimes" (Hasin, 2020: 82). One example of this "misguided fixation" comes from Frans G. von der Dunk, who notes that the phrase "common heritage of mankind" is featured in both the 1984 Moon Treaty and the 1982 Convention on the Law of the Sea. Thus, he argues based on the 1982 Convention's definition of "common heritage of mankind" that the Moon Agreement "may suggest some mandatory sharing of benefits and technology" when it comes to space mining (von der Dunk, 2017: 89-91).

Beyond the fact that the Moon Agreement has only one space-capable state as a signatory (Australia), the invocation of the 1982 Convention has little legal support. There is no suggestion that the Convention "relat[es] to" the Treaty or was made "in connection with the conclusion of the" Treaty – factors that under Article 31 of the VCLT would suggest referencing the Convention (Vienna Convention, 1969). Moreover, the sea and outer space are so different that absent legal text explicitly connecting the rules governing them, the Convention is a dubious source for interpreting space-law agreements. As just one example of the two fields' distinctions, areas designated as the "common heritage of mankind" in the sea do not reflect parties' high-minded ideals. Rather, the term obscures the fact that the "common heritage of mankind" is an area without known exploitable resources such as oil and natural gas (Hasin, 2023: 16). Thus, von der Dunk's comparison almost defies logic. He asserts that a requirement for "some mandatory sharing of benefits and technology" may exist, but areas that constitute the "common heritage of mankind" almost definitionally yield no benefits. The Law of the Sea's application to space mining is more like Breyer's citation of disanalogous foreign law than constitutional scholars' appropriate references to the Civil Rights Act of 1866.

Thus, there is some overlap in the textual interpretation methods employed in space law and constitutional law. Scholars in both fields emphasize the original meaning of legal texts, compare the language of different legal instruments, and sometimes err by analogizing distinct governance structures. However, the use of history highlights how the two fields are far from alike.

b. HISTORY

In constitutional law, jurists and scholars often consult history to understand the meaning of clauses – especially when a textual analysis does not yield a definitive answer. As the U.S. Supreme Court noted in *Washington v. Glucksberg*, "the Court has regularly observed that the [Due Process Clause of the Fourteenth Amendment] specially protects those fundamental rights and liberties which are, objectively, deeply rooted in this Nation's history and tradition." 521 U.S. 702, 703 (1997). In 2022, the Court engaged in a "long journey through the Anglo-American history of public carry" to conclude that New York had not "met their burden to identify an American tradition justifying the State's proper-cause requirement." Thus, the Court struck down the state's gun-licensing regime. *New York State Rifle & Pistol Association, Inc. v. Bruen*, 142 S. Ct. 2111, 2156 (2022).

Scholars have also focused on George Washington's presidency and the first few Congresses to discern the meaning of potentially ambiguous constitutional provisions. Indeed,

“the constitutional understandings that crystallized during the Washington administration have enjoyed special authority on a wide range of issues.” For example, the First Congress passed several statutes recognizing the president’s authority to fire the heads of executive departments at will – a precedent known as the “Decision of 1789” that is still followed today (Amar, 2012: 320-21). Beyond the actions of Washington and his subordinates, historical precedents in the years following the Constitution’s ratification have particular significance. For example, Saikrishna Bangalore Prakash cites Congress’s dictation of minute details in a late-1700s naval war against France to establish that Congress has “sweeping powers” to “micromanage” and regulate the President’s conduct of a war (Prakash, 2020: 157-58).

In the context of space law, history has a different function. Rather than providing greater clarity on specific provisions’ meanings, it can highlight gaps in legal instruments that render them inapplicable to modern space concerns. Emphasizing the O.S.T.’s Cold War context, Hasin remarks, “Cold War-era science fiction is becoming science fact, and the international rules must adapt to the changing realities or be abandoned as obsolete” (Hasin, 2020: 99). Not only did the O.S.T. not anticipate new technologies, but it also operated in a fundamentally distinct geopolitical environment. The U.S. and the Soviet Union were the only two actors in the space arena, and no private entities were involved in space, unlike today. Furthermore, the O.S.T. was driven by a “fear of extraterrestrial sovereignty claims” (99), rendering its language about “national appropriation by claim of sovereignty” impertinent to space resource extraction (Treaty, 1967: art. II).

In short, historical analyses play a much greater role in constitutional interpretation – especially for originalists – than in the constantly evolving legal regime that governs outer space. The opposite, however, is true when it comes to the legal weight of practice.

c. PRACTICE

Although text and history are widely accepted as tools for constitutional interpretation, the weight of practice is more contentious. In *Noel Canning v. N.L.R.B.*, 573 U.S. 513, 524 (2014), the Supreme Court held that “[l]ong settled and established practice is a consideration of great weight in a proper interpretation of constitutional provisions’ regulating the relationship between Congress and the President.” Such practice is especially suggestive when text and history do not provide definitive answers, as Akhil Reed Amar explains: “Particular attention must be paid to how Congresses and presidents over the years have worked things out between themselves, thereby glossing ambiguous patches of constitutional text with institutional settlements” (Amar, 2015: 74). For example, he relies on practices to determine that officials leading single-headed executive agencies may be removed at will by a president, but he or she may not unilaterally remove officers of multi-headed independent agencies (Amar, 2012: 381-86).

Not all originalists are so willing to rely on practice, however. Concurring in *Noel Canning*, Justice Antonin Scalia castigated the Court’s reliance on practice as “deferring to the Executive’s untenably broad interpretation of the power.” 573 U.S. 513, 570 (2014) (Scalia, J., concurring). Prakash has also rejected presidents’ continued reliance on past military engagements to justify expanding executive war-making authority absent congressional approval. For example, he notes that the State Department’s memorandum supporting President Harry Truman’s unilateral engagement in the Korean War without congressional assent relied on dubious historical precedents – including one example in which Congress had actually declared war and another in which President James Monroe explicitly viewed the seizure of

Spanish forts as unconstitutional. Thus, Prakash admonishes that “the practice of looking at practice and drawing lessons is extremely artificial and subjective” (Prakash, 2020: 163, 168).

In contrast to its highly disputed role in constitutional law, practice is significant in space law. The VCLT specifically says the following concerning treaty interpretation:

3. There shall be taken into account, together with the context:

- (a) Any subsequent agreement between the parties regarding the interpretation of the treaty or the application of its provisions;
- (b) Any subsequent practice in the application of the treaty which establishes the agreement of the parties regarding its interpretation (Vienna Convention, 1969: art. 31).

Indeed, practice itself may create international law. After all, one source of international law is “international custom, as evidence of a general practice accepted as law” (Statute, 1945: art. 38(1)(b)). Customary law requires “a consistent and virtually uniform practice among States, including those States specially affected by the rule or having the greatest interest in the matter.” Further, there must be evidence that States are following a putative custom because they believe that they are under a legal obligation to do so, as opposed to other self-interested motivations (Beckman & Butte, 2009).

Practice is also especially important to the New Haven School, which focuses on the interactions between actors and how the law may shape them. For example, Hasin analyzes the U.S.’s 2015 declaration of property rights over extracted space resources with a particular emphasis on the response of other nations. He thus notes that Russia was the only space-capable nation to oppose the U.S.’s claim and did so largely as a result of geopolitical issues as opposed to the merits of the issue.¹ Most notable, however, was China’s silence on the issue – which Hasin attributes to the nation’s potential interest in space resources as part of its Moon program (Hasin, 2020: 149). Given that China has clashed with the U.S. on numerous space issues, including militarization (Pekkanen, 2021), the two powerful nations’ seeming agreement on property rights suggests that it might be developing into an international norm.

Living constitutionalism and space law

The preceding sections yield three general conclusions. First, there exists general overlap in the textual methodologies employed in space law and constitutional law. Second, the historical evidence used by originalists has little use in space law, except to understand the deficiencies of legal instruments. Third, while the weight of practice is disputed in constitutional law – and when employed, usually applies only to separation-of-powers disputes – it is central to international law like space law. These conclusions suggest that the best analog to space law is not originalism, which generally stresses a fixed meaning or principle at the time of enactment, but rather the more flexible approach of living constitutionalism espoused by scholars like David Strauss.

Indeed, striking parallels exist between living constitutionalism and the development of space law, especially following the New Haven School. To start, some of the same principles are at the heart of both legal theories. For Strauss, “it is legitimate [for judges] to make judgments about fairness and policy,” based on tools and notions such as “commonsense

¹ This interpretation of Russia’s opposition was confirmed by its subsequently declared interest in mining space resources (Soldatkin, 2019).

empiricism,” “common sense, based in experience,” and “good policy” (Strauss, 2010: 39, 41, 47). Strauss’s ideas strongly resemble Hasin’s vision for “a global order for space resources.” Just as Strauss emphasizes fairness and good policy, Hasin envisions an international order built around values such as access to wealth, equity, health and safety, and human dignity (Hasin, 2020: 125-31). Meanwhile, the New Haven School’s reliance on a “full and realistic description of...power processes,” policy-oriented approach, and willingness to employ social science tools aligns well with Strauss’s focus on common sense and empiricism (Reisman et al., 2007: 575-76, 580).

The similarities between living constitutionalism and space law are also evident in the treatment of practice. As discussed in Section II.c, originalists and international lawyers view practice very differently. While Prakash strongly rejects the Executive Branch’s historical use of practice to justify expanding military powers, the Court has emphasized practice to answer separation-of-powers questions. In contrast, customary international law is itself created by practice, and scholars look to nations’ interactions and responses to identify, for example, the viability and development of international norms. Strauss’s view aligns much more closely with Hasin’s than Prakash’s: “If a practice or an institution has revived and seems to work well, those are good reasons to preserve it; that practice probably embodies a kind of rough common sense.” Thus, Strauss cites the widespread implementation of affirmative action policies as the legal basis for its practice, despite conceding a lack of “consensus on its abstract justification” (Strauss, 2010: 41-42).

A third parallel between living constitutionalism and space law is the recognition that different times require different legal rules. Central to Strauss’s argument against originalism is that one generation cannot bind a future generation, and in any event, we cannot reasonably discern how the Framers would view contemporary constitutional controversies (21-25). Hence, he advocates for a common-law approach that flexibly acknowledges and adapts to “a large, complex, diverse, changing society” (34-35). Hasin’s work in space law reflects similar principles. His citation of the O.S.T.’s Cold War context to highlight its distinct geopolitical and technological contexts parallels Strauss’s rejection of the Framers’ ideas (Hasin, 2020: 99). Meanwhile, his proposal of “a novel regime evolution approach to the regulation of space resources” revolving around four different developmental stages mirrors Strauss’s commentary on the evolutionary nature of the law (148-58).

Indeed, we are already seeing examples of space law changing with the times. The Artemis Accords of 2020 assert “that the extraction of space resources does not inherently constitute national appropriation under Article II of the Outer Space Treaty” – a reference to the O.S.T.’s declaration that “[o]uter space, including the moon and other celestial bodies, is not subject to national appropriation” (Artemis Accords, 2020: § 10; Treaty, 1967: art. II). While scholars disagree about whether the Artemis Accords’s interpretation of the O.S.T. is correct, it is fair to say that the O.S.T. did not anticipate space mining by private companies (Hasin, 2020: 93-97). Thus, the U.S. and its allies have engaged in amendment via interpretation. Given the low likelihood of major international agreements replacing the O.S.T. soon, such amendments are likely to continue: “the Outer Space Treaty will either evolve through interpretation or be rendered obsolete in the process” (99). While living constitutionalists would celebrate this flexible approach, originalists would be appalled by the notion that the Constitution’s text could ever be obsolete and require amendment via interpretation.

This Part has highlighted similarities and differences between constitutional law and space law, shedding light on key aspects of and tools in the two fields. For constitutional

scholars aiming to wade into space law, they should explore this field with the lens of living constitutionalism's flexibility, as opposed to originalism's rigidity. However, it is unclear whether living constitutionalism includes analyses that space lawyers should add to their repertoire. To the extent that space scholars should study constitutional interpretation, it would primarily be to understand how constitutional scholars approach issues that exist in both fields – such as assessing governmental involvement or interpreting aspirational language, as discussed in Part VI. We now turn to an area in which constitutional law may be more useful: rule promulgation.

Rule promulgation: leveraging the veil of ignorance

In his 1971 book *A Theory of Justice*, philosopher John Rawls “aimed to identify fair governing principles by imagining people choosing their principles from behind a ‘veil of ignorance,’ without knowing their places in the social order” (Rawls, 1999; Huang et al., 2019: 23989). Rawls’s suggestion was simple: if an individual does not know his or her own characteristics, then he or she will not be influenced by personal biases and can focus more objectively on fairness. Rawls’s powerful idea has implications for crafting legal rules. Amar has invoked this framework to argue for constitutional amendments that “sunrise,” taking effect decades after enactment (Amar, 2012: 474-77). At the same time, Hasin highlights how “the current veil of ignorance concerning space resources” may induce “more risk averse space-capable states...to make compromises to secure other interests” (Hasin, 2020: 131). Thus, the promulgation of new space-governance regimes could draw from ideas about constitutional creation and amendment.

Before addressing the potential applications of the veil of ignorance in space law, it is worth seeing how constitutional drafters and scholars have utilized the idea. One notable and infamous example is the U.S. Constitution’s Slave Trade Clause, which declared that “[t]he Migration or Importation of [slaves]...shall not be prohibited by the Congress prior to the Year one thousand eight hundred and eight” – twenty years after the Constitution’s ratification (U.S. Constitution: art. I, § 9, cl. 1). While a short-term concession to southern states that wanted to continue importing slaves, both pro- and anti-slavery factions were amenable to this compromise, without which James Madison and Oliver Ellsworth warned the Constitution might not survive (Amar, 2006: 120). Southerners believed that the slave population would grow so large by 1808 that there would be a congressional majority against banning the slave trade, while northerners such as James Wilson predicted the opposite: that Congress would end the slave trade and establish a “foundation for banishing slavery out of this country” through “gradual change” (164). (Wilson and the northerners were correct in the end.)

Constitutional scholars have routinely used the veil-of-ignorance idea to propose corrections to various aspects of the Constitution they disagree with. For example, Amar has applied the principle to changing the U.S. Senate from a body in which every state has two senators to one that has proportional representation. He reasons that if such a change occurred with a decades-long time delay, senators from small states might be willing to consider the interests of grandchildren and great-grandchildren who may live in a large state. Given this uncertainty, senators would ideally “consider what is truly fair and just,” devoid of “biased considerations of personal self-interest” (Amar, 2012: 475). A similar principle could also be used to remove the Speaker of the House from the presidential line of succession due to constitutional concerns (Calabresi, 1995), or change the presidential election system from the

Electoral College to a popular-vote-based system. In both cases, a delayed implementation would enable politicians from both parties to set aside the short-term political implications of constitutional changes and focus on broader principles of fairness.

The above examples from U.S. constitutional law illustrate that applying the veil of ignorance to rule promulgation requires a delicate balance between certainty and uncertainty. Parties must know enough about the subject to prescribe specific rules about them – concentrating specifically on slave importation or the Senate’s composition, for example, as opposed to spouting vague principles – but have sufficient uncertainty about the outcome to prevent short-term implications from scuttling negotiations. One space-related example of the certainty/uncertainty balance leading to international agreement is the O.S.T. At the time of its agreement, the U.S. and Soviet Union knew that they were competing to land on the Moon first. Yet neither country had done so. Thus, they formed an agreement based on their mutual “fear of extraterrestrial sovereignty claims” (Hasin, 2020: 99).

Today, there are three areas in which an appropriate certainty/uncertainty balance could induce international agreement using a veil of ignorance: resources, debris, and militarization.

Starting with resources: in the first stage of international space-resource extraction, there exist sufficient quantities of resources but few parties capable of extracting them. This combination diminishes conflict such that “a claim for equal access to the resources on the market might be acceptable to the space-capable states due to the current veil of ignorance.” Because states do not know what resources they will and will not be able to extract, they have incentives to promote a free-market environment that would enable them to purchase resources that they cannot procure on their own (152). Nations not currently close to having resource-extraction capabilities might also avoid denouncing property rights to avoid hamstringing their future extraction endeavors – even if they may seem far off now. One example of this phenomenon is China’s silence on the U.S.’s 2015 assertion of property rights, given that their Moon program might eventually include resource extraction (as noted in Section II.c) (148-49).

A veil of ignorance could also lead to new rules regarding space debris. As of January 2022, there were 500,000 to 900,000 untracked items in space. A member of the International Academy of Astronautics’ Space Debris Committee quipped that “we just cross our fingers and hope we will not be hit by” them (Erwin, 2022). Yet because there have not been major space-debris disasters and all satellites in space are in theory equally likely to be hit (proportional to their size), there might be room for international cooperation to mitigate and remove space debris. All states with objects in space could be affected by debris, and without a specific accident yet, states cannot focus solely on retribution.²

Another fruitful area for a veil of ignorance to induce critical regulations is the militarization of space. As Saadia Pekkanen has highlighted, there are many unresolved legal issues in this domain, such as the definition of a space “weapon” and differentiating between civilian and military assets in space. These problems have been exacerbated by the dual-use nature of space

² One issue might be that the U.S. has a disproportionately significant number of space satellites and thus would be under pressure to commit more resources to address debris. However, it should not be afraid to make this greater commitment given that it has more at stake. More importantly, the space-debris situation is far from a climate-change scenario in which poorer, developing nations can specifically blame the carbon emissions of developed nations for causing natural disasters and requiring climate adaptation. Because there have not been any major accidents yet, Russia and China cannot plausibly blame the U.S. for all space-debris-related issues. Rather, all space-capable states are affected by a potential Kessler syndrome.

technologies accelerating military innovation and the competing blocs of U.S.-led allies on one side and Russia and China on the other (Pekkanen, 2021). While Russia raised the possibility of targeting U.S. commercial satellites used to support Ukraine in 2022, direct military conflict between powerful space-capable nations has yet to arise (Simmons & Maidenber, 2022). The U.S., Russia, China, and other major actors should leverage this veil of ignorance – when they do not know the exact players and circumstances of a space conflict – to promulgate rules that will protect civilians.

The International Committee of the Red Cross has highlighted how “[c]ritical civilian infrastructure needed for health care, transportation, communications, energy and trade is increasingly dependent on space systems,” while “weather, communication, navigation, and earth observation/imaging satellites...contribute to every phase of humanitarian work” (International Committee of the Red Cross, 2021). Thus, clear distinctions between civilian and military objects in space are imperative, lest a nation unintentionally cripple civilian systems while seeking military advantage. To avoid such accidents, nations could agree to use some satellites solely for civilian purposes and others solely for military purposes, without any overlap. This is just one area where rules about war can be adapted to the realities of space, so that *ad hoc* regulations are not created when a military conflict occurs.

Structural differences between a constitution and international legal instruments

While constitutional law may be particularly relevant to space law in terms of rule promulgation, there are strict limits on its broader relevance—as disparities in the treatment of history and practice show. Domestic law and international law are fundamentally different. Constitutions are generally enforced by courts via judicial review and create governmental institutions with policymaking authority. Meanwhile, international law contains relatively weak enforcement mechanisms, including the potential for action by a United Nations Security Council in which the U.S., United Kingdom, France, Russia, and China all have vetoes (United Nations, 1945: arts. XXIII (1), XXV, XXVII (3)). These differences, among others, compel a space-governance regime that goes beyond just interpreting and applying legal texts. Thus, Hasin takes a “regime evolution approach” that is “feasible, effective, and manageable,” using the New Haven School’s focus on “the interactions between the various participants” (Hasin, 2020: 82, 116).

The lack of enforcement internationally is worth emphasizing. Consider the text of the O.S.T. – perhaps the most important document in space law. Article IX, in part, reads as follows:

If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space...would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space...*it shall undertake appropriate international consultations* before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space...would cause potentially harmful interference with activities in the peaceful exploration and use of outer space...*may request consultation* concerning the activity or experiment (Treaty, 1967).

To the extent that the O.S.T. anticipates conflicts between states, Article IX contains its strongest language.³ Yet the Article's requirements have very little practical significance. States could easily declare that they envision no potential harmful interference with other states and thus not proactively consult others. Even if a state requests consultation, nothing in Article IX compels it (and no other legal enforcement mechanism exists for ensuring any consultations). Moreover, there are no substantive or procedural requirements for the consultations aside from their occurrence – and crucially, no obligation to follow through on any commitments made during consultations.

Toothless language is not unique to the O.S.T.; it is common in international space-law instruments. For example, the 1972 Liability Convention requires parties to establish a Claims Commission if one year of diplomatic negotiations fails and a party requests one. However, a Commission's decision is "final and binding *if the parties have so agreed*." If such consent is not given, "the Commission shall render a final and recommendatory award, which the parties shall consider *in good faith*" (Convention, 1972: arts. XIV, XIX (2)). This "good faith" requirement is meaningless: "Where it comes to affecting policy choices of States, non-legally binding dispute settlement produces the same result as 'consultations' with the other State; very little" (Hasin, 2023: 23). With this background on enforcement (or lack thereof) in space law, we now turn to whether the O.S.T. is truly a constitution for space.

The outer space treaty as a constitution?

Numerous scholars have casually suggested that the O.S.T. is tantamount to a space constitution. Without much analysis, S. Neil Hosenball averred that "[i]t is generally accepted that the Outer Space Treaty of 1967 is the basic charter or constitution governing space activities" (Hosenball, 1979: 98). Joanne Irene Gabrynowicz more carefully called the O.S.T. "quasi-constitutional" because "it functions like a constitution for space"; any revisions would open the entire document up to change, just as a constitutional convention would (Gabrynowicz, 2006: 114). Despite this narrow area of overlap, suggestions that the O.S.T. is like a constitution reveal a fundamental misunderstanding of constitutions' roles.

There exist numerous aspects of constitutions that the O.S.T. lacks. First and foremost, the O.S.T. does not create or even discuss any governing institutions or structures – much less establish procedures for selecting officials to run such institutions. It does not include a mechanism for establishing a Claims Commission, as the Liability Convention does. Nor do all international instruments lack provisions concerning governing institutions. The United Nations Charter, for example, established various "principal organs" and provided rules for selecting members of bodies like the Security Council, in addition to highlighting the document's "Purposes and Principles" (United Nations, 1945).

Additionally, one of the central ideas of a constitution is that it is meant to be followed and respected by individuals and institutions who operate under it. The U.S. Constitution declares that it "shall be the supreme Law of the Land" (U.S. Constitution: art. VI). Although parties still claim to follow the O.S.T., few would assert that it is adhered to with the reverence that

³ Note that Article XII also includes language about consultations: "All stations, installations, equipment and space vehicles on the Moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity. Such representatives shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited" (Treaty, 1967).

Americans afford the U.S. Constitution. One reason for this distinction is the O.S.T.'s absence of enforcement, as discussed in Part IV. In contrast, the Constitution provides numerous means to identify and prevent constitutional violations – including, but not limited to, judicial review (Amar, 2006: 60-63).

Furthermore, the U.S. still operates under the same basic governmental structure as it did when the Constitution started operating in 1789. There are still three branches of the federal government, with a bicameral Congress passing laws that the President signs or vetoes subject to potential congressional override (U.S. Constitution: art. I, § 7). Amendments expanding the franchise or changing the balance of federal and state powers have operated under this framework, and developments such as the growth of the administrative state or even the codification of property rights for space resources have been passed through the same lawmaking process that the original Constitution outlined.

Because the O.S.T. does not establish governing structures, its historical context is more significant. While it was driven by Cold War superpowers, today's world is markedly different. The Soviet Union does not exist, and China is arguably a more significant player in space than Russia. The number of space-capable nations has grown, and space exploration has expanded beyond landing on the Moon. Private entities play a large role in space exploration, contrary to the state-driven Cold War era. Thus, as noted in Section II.d, Hasin reasonably suggests that “the Outer Space Treaty will either evolve through interpretation or be rendered obsolete in the process” (Hasin, 2020: 99). In contrast, a claim that the U.S. Constitution could be “rendered obsolete” would be highly dubious.

If the O.S.T. is not a constitution, then what is it? One suggestion might be a super-statute akin to the U.S.'s Social Security Act of 1935, which established retirement aid and unemployment insurance, among other benefits. Just as subsequent instruments like the Liability Convention and the Artemis Accords have claimed to follow and build on the O.S.T., numerous statutes have amended the Act since its 1935 passage – most significantly the Social Security Amendments of 1965, 79 Stat. 1432 (1965), when Medicare and Medicaid were established. Yet the O.S.T. is still weaker than the Act. The Act's provisions are executed by the executive branch, subject to oversight by the legislative branch, and enforced by the judicial branch. The Act and its progeny also provide specific benefits and outline various procedures, unlike the O.S.T.'s broad declaration of principles and general requirements for consultations.

Perhaps the best comparison then is to constitutional preambles, which set out broad principles that undergird the legal regime set out by the document's body. The U.S. Supreme Court has established that the Constitution's Preamble “has never been regarded as the source of any substantive power conferred on the Government of the United States,” mirroring the O.S.T.'s lack of enforcement mechanisms. *Jacobson v. Massachusetts*, 197 U.S. 11, 22 (1905). Yet preambles are still significant in the messages they convey. The U.S. Constitution's language that “We the People of the United States...do ordain and establish this Constitution” distills the idea of popular sovereignty that undergirds the entire document (U.S. Constitution: Preamble). Meanwhile, the German Basic Law's preamble lists all the *länder* (what the U.S. would consider “states”), emphasizing the importance of federalism in Germany, while phrases in the South African Constitution's preamble such as “[r]ecognise the injustices of our past” and “[h]eal the divisions of the past” reflect the document's rejection of apartheid (Grundgesetz; S. Afr. Constitution).

Similarly, the O.S.T. establishes – in greater detail than some constitutional preambles – principles that have guided space activities since 1967. These ideals include space as “the

province of all mankind”; non-appropriation; “international peace and security...and international cooperation and understanding”; a prohibition on weapons of mass destruction in space; governmental supervision of private entities; and the return of personnel and equipment (Treaty, 1967: arts. I-VI, VIII). Indeed, framing the O.S.T. as a preamble has aesthetic beauty. It implies that humanity has the responsibility to continue developing a legal regime for outer space as new technological capabilities and geopolitical relationships arise, based on these guiding ideas. While instruments such as the Liability Convention and Artemis Accords have sought to meet this duty, we all have a role to play in shaping space activities of the present and future. After all, it is all of our “province” (art. I).

Conclusions

While constitutional law and space law are distinct legal fields, an understanding of the former provides insights into the latter. From an interpretive perspective, some overlap exists in the use of text in the two fields, but originalists stress history more and practice less than space lawyers. Thus, living constitutionalism as espoused by scholars like David Strauss provides the best parallel to space-law interpretation. However, the most useful contribution of constitutional law is in rule promulgation. Just as the Framers used and scholars have proposed leveraging a veil of ignorance to address significant issues while avoiding short-term biases, policymakers can utilize this notion to promote rules about space resources, debris, and militarization before conflicts require *ad hoc* arrangements or prevent international agreement altogether. Nevertheless, significant structural differences admonish against an indiscriminate application of constitutional law to space law, debunking suggestions that the Outer Space Treaty of 1967 (O.S.T.) is like a constitution for space. Still, viewing the O.S.T. as a preamble emphasizes humanity’s collective responsibility to continue establishing and adapting norms for the rapidly evolving realm of space.

Informed by this Article’s discussion of the appropriate consultation of constitutional law for space-law issues, future scholars can analyze issues that affect both fields. Two are worth highlighting. First, like liability shields for social-media companies raise questions about governmental involvement in their operations (Ramaswamy & Rubinfeld, 2021), disagreement exists on the extent to which corporations’ space activities can be considered governmental action (Hasin, 2020: 93-97). Second, space treaties’ aspirational language resembles positive-rights guarantees in various constitutions. Thus, the implementation of broad language like “the right to have access to adequate housing” in the South African Constitution may shed light on the O.S.T.’s language about space use and exploration “be[ing] carried out for the benefit and in the interests of all countries” and for “the province of all mankind” (S. Afr. Constitution: ch.2; Treaty, 1967: art. I).

Undoubtedly, there are more issues with potential overlap, and thorny space-law questions that we cannot imagine today will arise just a decade or two from now. Should scholars and policymakers look to constitutional law to address novel controversies—just as they have invoked the Law of the Sea – this Article can guide the appropriateness of such consultations. Regardless of the sources we turn to, future challenges for space activity require novel and creative thinking, and a willingness to embrace the responsibility of outer space being all of our “province.”

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Does Dual Use of Satellites Challenge the Future Space Governance?

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The dual use of satellite services raises the question about the legitimacy of the counter actions against their functionality during the armed conflict. This article focused on the examination of the content of the key principles of international humanitarian law, i.e. distinction and proportionality, concerning their application to the space activity. In this context, the criterions of pre and post evaluation of input of space services to the military operation were analysed. The risk of creation of a cloud of space debris because of a breach of humanitarian law was also observed. As a result, the suggestion to develop and ratify Additional Protocol IV that would distinguish what constitutes a civilian object from a military objective and determine the scope and extent of damage proportional to the attack, is argued as a means that able to save outer space resource and space services during the space and cyber wars.

Keywords: security, distinction, proportionality, outer space, armed conflict

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Introduction

“As the role of space systems in military operations during armed conflicts increases, the likelihood of these systems being targeted also increases, with potentially significant impacts for civilians on Earth.” These words of the legal adviser of the International Committee of the Red Cross at the session of the Open-ended working group on reducing space threats through norms, rules, and principles of responsible behaviour (Open-ended working group, May 2022) represents the common conviction that the expression “peaceful exploration and use of outer space” allows for military conflicts from, though, and in outer space. This idea bases on the factual, political, and juridical challenges faced by commercial operators as the result of invasion of russia into Ukraine. As a result, some start-ups lose their motivation to provide data by stating that it’s not clear that even well-funded and smart commercial entities could stand

up to the might of a nation-state advanced persistent threat because they are inviting a level of cyber attacker that their information-security apparatus are not prepared for (Werner, 2022).

During the war in Ukraine, for the first time in history, space-based capabilities significantly changed the balance of the conflict, because a lot of private companies deliver reports from their radar imagery to better orientation what's going on the ground, or on the sea of Ukraine. This leads to a wave of political critics with the juridical explanation that indirect involvement of civilian, including commercial, infrastructure in outer space for military purposes makes it a so called quasi-civilian infrastructure that may become a legitimate target for retaliation (Open-Ended Working Group, September 2022).

This conclusion comes from art. 3 of OST that extends all international law, including humanitarian law, into space activity as well as a Martens Clause that prescribes, until a more complete code of the laws of war will be issued, the populations and belligerents remain under the protection and empire of the principles of international Protocol (I AP) to the Geneva Convention revealed the characteristics of military objective and rule 14 of international customer law (ICL) (proportionality) as well as art. 51 of I AP (indiscrimination) and art. 54 of I AP and Rule 45 ICL (widespread, long-term, and severe damage), etc (International Red Cross). In this regard, the cornerstone question of equilibrium between principles of distinction and proportionality as a representative of the more general principles, namely the military necessity and humanity arises.

The means of European space defence policy

There are at least two areas in which Europe can play a leading role: monitoring and mitigating climate change and reducing space debris (Space 2040: The Future of the Global Space Economy, 2023). The Action Plan on synergies between the civil, space and defence industries prescribes that the European defence industry should be able to draw on the research results of the EU's civil industry to avoid costly duplication of research. The strategic compass sets two objectives for the space sector: firstly, to strengthen dual-use innovation (military mobility); secondly, to invest in space situational awareness to better understand and reduce space-related risks, threats, and vulnerabilities (A Strategic Compass for Security and Defense, 2022). European space policy is therefore focused on space situational awareness to prevent threats, including offences, to satellites and dual-use systems.

The same trends are reflected at national level, where France's Space Strategy of Defence (SSD) focuses on two main elements: an improved space surveillance capability to detect and attribute unfriendly acts; and a capability to defend critical space interests. The French doctrine, like the European one, compared with the American one, does not develop a complete control of space but rather guarantees its freedom to use this environment in all circumstances, according to the satellites in all fields of use. The central approach here is a frequently evoked strategy of autonomy in circles, following three distinct circles for space surveillance, i.e. a controlled patrimonial circle that carries the core of the mission, an enlarged circle which includes trusted players to reinforce operational capabilities in a strictly organised manner according to the type of missions targeted, and a last, even wider circle opening up possible commercial relationships capable of meeting needs whose volume and nature exceed the capabilities offered by dedicated resources (Pasko & Wohrer, 2023). In this context, while respecting the civilian nature of EU space programmes, specific and adapted rules for the provision of security-sensitive services, applications and data are established to ensure the

appropriate level of confidence for users in the security and defence sectors (Joint, 2023). Thus, even despite non-aggressive policies, due to the strategy of involving private satellites in defensive operations, they risk being affected in the event of an attack or irresponsible behaviour.

Current defence mechanisms

According to section 3 of the European Union Space Strategy for Security and Defence, the response to threats consists of:

- ✓ Detection: Space Domain Awareness (SDA) to describe and understand behaviours in real time.
- ✓ Attributing and reacting to hostile behaviour: The European External Action Service (EEAS) manages the Space Threat Response Architecture which supports the implementation of the Council Decision on the security of systems and services deployed, operated, and used under the Space Programme. They identify threats to the baseline references contained in the system-specific security requirement statements and the respective system security plans, which include the security risk registers established in the security accreditation processes for each component. It is therefore an internal regulation that cannot respond to the understanding of threats by someone who does not belong to that system. In addition to the technical response, relevant EU tools could also include:
 - at the diplomatic level – discussions in multilateral fora, awareness-raising through the appropriate channels and declarations by the EU and the Member States aimed at preventing and responding to irresponsible behaviour in the space field
 - at the economic level – tools such as sanctions.

The principle of distinction

The problem of distinction grounded on the phenomenon that from 4,800 operational satellites approximately two-thirds are commercially owned and the services of them could be used both for the military and civil purposes (International Red Cross) (so called problem dual-used services). The situation aggravated by the well-known problem of non-transparent and unclear registration of space object. As an example, P. J. Blount mentioned that SA-193, a National Reconnaissance Office remote sensing satellite, as well as civil remote sensing satellite Landsat 5, were listed at UN registry as spacecrafts engaged in practical applications and used of space technology such as weather or communications (Blount, 2012). So, if in the time of the conflict someone wants to misfunctioned such satellites, it is not obviously that it will be legally, because the destruction of both could violate the principle of proportionality and they could not realize mentioned civile services.

As a criterion to legalize the targeting belligerent satellites art. 52 of I AP are used, namely “the military objectives are limited to those objects which by their nature, location, purpose or use make an effective contribution to military action and whose total or partial destruction, capture or neutralization, in the circumstances ruling at the time, offers a definite military advantage.” On this base some scientists stated that: 1) military rockets, military satellites, military spacecraft, military spaceships or military space stations meet the “nature” standard under normal circumstances; 2) in the case of civilian satellite is used to provide energy

supplies for enemy military satellites, or is used as a bodyguard satellite to protect important enemy military satellites, it can be considered a military target because of its location and, vice versa, certain military target may no longer be considered a military target due to a change in location; 3) under the “current use” criterion, a civilian object becomes a military object when it is used for military purposes. “Purpose” refers to the intended future use of an item. For example, a civilian transponder on a communications satellite becomes a military target if there is credible information that an adversary intends to use it for military purposes. Wenjun Yan and Haoyu Cui from China Foreign Affairs University explains that such contributions must be made on a “real-time” basis and not based on hindsight (Yan & Cui, 2023). Changes in the location, right to use, and ownership of a space object may cause that the last one to no longer provide military benefits “under the circumstances” and thus no longer constitute a legitimate target of attack. Thus, for effective distinguishing military and civilian functions of dual-use space objects, the Chinese colleagues suggests providing detailed information to the enemy. Such suggestions cannot be effectively used according to the two reasons: 1) terms “nature, location, purpose or use, effective contribution” concerning their application to space activity leave a lot of subjective estimations of each belligerent party and bring the risk of irreversible malfunctioning a huge amount of civil satellites; 2) real-time estimation of status of satellite on the base of active exchange of information between belligerent states looks like utopian situation and open up opportunities to abuse this option.

P. J. Blount suggest more scrutiny approach of evaluation of real input into the military operation, as the result he estimates that intelligence-gathering centres related to the war effort, like Geo-Eye satellites, that helped the military strategists of US to provide invasion in the Afghanistan in planning and execution of the ground operations, are considered to be targets, as well as the commercial telecommunications satellites which assisted the military with command and control type functions also make themselves up as potential targets (Blount, 2012). The weakness of this approach in the post-estimation of such activity, but in comparison with the previous one, it gives more evidence and can prevent the escalation of the conflict in space.

As an another case of estimation of the status of such services, the remote sensing imagery is difficult to consider as a “war material,” if it was provided by a commercial vendor, especially in the case of procurement of the raw data that can be processed under different aims as well as satellite images for the humanitarian purposes, like it was at the first months of the russian invasion in Ukraine, when Maxar and other operators provided satellite images to prove the war crimes of the russian army and to help the government of Ukraine to provide safely evacuation of civilians. It’s indispensable do not forget that humanitarian law based on the principles of humanism and stay aside of atrocities due to the threat of force of aggression is to be part of the crime against humanity.

The art. 52 I AP correspond the principle of continued protection, according to which, in case of doubt whether an object which is normally dedicated to civilian purposes is being used to make an effective contribution to military action, it shall be presumed not to be so used. In this light the collision between diplomatic status of astronauts as envoys of humanity and the representatives of the national military division is solved, with some exceptions (Jie, 2019), from the perspective of the behaviour as a hostile or non-hostile (Yan & Cui, 2023) or “fundamental change in circumstance” (Blount, 2012). This conclusion is validated by the art. 13 of the Second Protocol to the Geneva Convention, civilians shall enjoy the protection afforded by this Part, unless and for such time as they take a direct part in hostilities and in the more recently act.

In conclusion of this part, it should be noticed that art. 52 of the I AP permit to make an attack concerning above mentioned objects and subjects. Thus, according to the article 49 of I AP, attack is an act of violence against the adversary, so it should be proportional.

The principle of proportionality

When we think about proportional attack in space, it is about the risks of space debris (so called “secondary impact” or even “tertiary impact”) and about the harmful consequences for the humanitarian needs on the Earth. Both is interdependent and provide a serious argument for non-use of force. For example, Cassandra Steer is convinced that even military technology as the Global Positioning System would likely always be prohibited because of the enormous civilian dependency that have free access in many countries (Steer, 2023).

Here are some manifestations of this principle:

- ✓ Rule 14 prescribes that launching an attack that may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated, is prohibited.
- ✓ Article 51 of the I AP reveals the criterion attacks indiscriminate: (a) those which are not directed at a specific military objective; (b) those which employ a method or means of combat which cannot be directed at a specific military objective; or (c) those which employ a method or means of combat the effects of which cannot be limited as required by international humanitarian law.
- ✓ Art. 55 of the I AP stated that care shall be taken in warfare to protect the natural environment against widespread, long-term, and severe damage. Nevertheless, that the art. 56 gives the exhaustive list of the works or installations containing dangerous forces, that is not contain satellites, which should be covered by this article in the sense of the creation of space debris and risk of harm to other satellites.
- ✓ According to the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, each State Party undertakes not to engage in military or any other hostile use of environmental modification techniques having widespread, long-lasting, or severe effects as the means of destruction, damage, or injury to any other State Party. Debris significantly harms economic interests in space by placing multimillion-dollar assets at risk and poses a threat to the natural resource of orbits, so such norm recognized like applicable to the situation of the use of force in space.
- ✓ According to the principle of military necessity that permits only that degree and kind of force required to achieve the legitimate purpose of a conflict, i.e. the complete or partial submission of the enemy at the earliest possible moment with the minimum expenditure of life and resources, it is difficult to imagine that the belligerent State with a lot of satellites in their jurisdiction on the same to near orbits ma let possible the creation of huge debris.

So, it became clear that using of kinetic means to out of work the hostile satellite is became unlikely. At the same time, it is worrying that attacks that use technologies that provide jamming or spoofing attacks on telecommunications or navigation satellite as well as dazzle or blind a remote sensing satellite and at least cyber-attacks recognized as permissible. They don't violate the requirement of the indiscriminate attack because they serve to disrupt the satellites usefulness to the adversary and not to destroy the satellite itself (Blount, 2012).

Nevertheless, Liang Jie also highlight that each attack on the satellites may break the proportionality principle because military facilities depend heavily upon satellite positioning systems. Once the satellite positioning systems are interfered with, the weapons will not be able to target accurately, they may attack non-military objectives and violate the principle of proportionality (Jie, 2019).

Conclusions

For the conclusion, it should be noted that space and cyber technologies require the more precisely interpretation of the key principles of international humanitarian law like distinction and proportionality for achieving their equilibrium according to the specific characteristics of these domains. As Jack M. Beard conjectured, the application of new space technologies will make combat more automated, and armed conflicts in outer space will rely more on the evaluation of combat methods by legal advisers that rise appreciation by commanders of the utility of legal support in their multidimensional missions, and the growing use of law as a strategic asset (Beard, 2009).

At the same time, even the most intelligent lawyer cannot take responsibility for the space and cyber war according to the restrictions of subjective comprehension or belonging to certain jurisdiction, etc. So, as it was admitted by P. Pascucci concerning cyber war, the application of the principles of distinction and proportionality fail to adequately provide protection of the civilian population because the definitions and current application are based upon the historical application to kinetic warfare. In this regards the suggestion to develop and ratify Additional Protocol IV that would distinguish what constitutes a civilian object from military objective and determine the scope and extent of damage proportional to the attack, could be seen as a means that able to save outer space resource and space services during the space and cyber wars (Pascucci, 2017).

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Satellite Navigation in Ukraine: Legal Frameworks and Implications for Space Security

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This article provides a comprehensive analysis of Ukraine's satellite navigation development, focusing on the evolution of its legal frameworks in the context of ongoing regional conflict. It examines historical and current aspects of Global Navigation Satellite System (GNSS) development in Ukraine, highlighting the intersection of technological innovation, international cooperation, and Ukraine's role in global space initiatives. Special attention is paid to the 2023 bill "On State Regulation in the Sphere of Satellite Navigation," emphasizing its critical role in national security and defense. The article underlines the need for robust legal and regulatory structures, professional expertise, and public-private collaboration to adapt to rapid industry changes and integrate effectively into the global space market.

Keywords: Satellite Navigation, Ukraine Legal Frameworks, Global Navigation Satellite System (GNSS), Space Law, National Security.

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Introduction

In today's globalized world, satellite navigation is indispensable across various sectors, ranging from personal mobility to international logistics and global security. Major satellite navigation systems like the GPS (Global Positioning System), GLONASS (Global Navigation Satellite System), and Galileo are integral to industries such as transport, agriculture, military operations, and emergency services.

The United States-developed GPS is renowned for its high precision and broad applications. Salvemini (2001) in the "International Encyclopedia of the Social & Behavioral Sciences" describes GPS as a radio wave receiver that provides exact positioning in space through signals

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from a constellation of orbiting satellites. Capable of extraordinary precision, GPS can pinpoint locations to less than a millimeter under optimal conditions and extended observation periods. Its most significant contribution to modern society lies in providing real-time geographical coordinates of any object on Earth's surface, greatly enhancing our knowledge with direct and cost-effective geographical data. Nevertheless, GPS usage does raise social issues, including concerns about privacy and the potential impact on natural orientation skills (Salvemini, 2001).

Galileo, developed by the European Union, is known for its heightened accuracy and reliability, especially in urban settings. Breeman, Grillo, and van de Kaa (2022) in "Journal of Engineering and Technology Management" posit that GPS and Galileo are likely to become the dominant GNSS systems, surpassing GLONASS. They emphasize the roles of technological superiority, operational supremacy, and brand reputation in GNSS standard dominance. The research indicates that GPS and Galileo are closely matched in these areas, while GLONASS appears to lag (Breeman et al., 2022).

However, Vidal and Privalov (2023) report in "Space Policy" that GLONASS is seeing significant advancements, with the Russian armed forces upgrading from the older GLONASS-M to the newer GLONASS-K satellites, reflecting Russia's dedication to improving and maintaining the system's relevance (Vidal & Privalov, 2023).

The integration of these satellite navigation systems plays a crucial role in enhancing the efficiency and accuracy of a myriad of processes, thus contributing significantly to global security, economic development, and sustainable resource management. These systems facilitate the precise positioning of objects on land, sea, and air by utilizing geographical coordinates to determine location, exact time, speed, and direction of movement. The effectiveness of satellite navigation hinges on the seamless integration of electronic-technical systems, which synergize ground and space-based equipment.

The legal framework governing these systems, particularly in aspects of positioning and communication, necessitates adherence to international legal norms. Prominently, the principles of international law, as outlined in the Charter of the United Nations, obligate states to engage in international cooperation across economic, social, cultural, and humanitarian domains, while also committing to the preservation of international peace and security. Additionally, the International Convention on the Use of Radio Broadcasting of 1936 plays a critical role, as it prohibits the dissemination of information from one state's territory that could potentially jeopardize the internal order or security of another state. Equally significant are the United Nations Principles that regulate the use of artificial Earth satellites for international live television broadcasting, as well as the Convention on the Distribution of Programme Carrier Signals Transmitted through Satellites, which collectively guide the operational standards and ethical considerations in this sphere (Galagan, 2013).

The Global Navigation Satellite System (GNSS) represents a technological breakthrough, revolutionizing various facets of our lives, including cartography and personal navigation. A key component of this system is the International GNSS Service (IGS), which comprises over 500 surveillance stations worldwide. These stations play a crucial role in providing three-dimensional positioning and speed determination, thereby enhancing the accuracy and reliability of the global navigation infrastructure (Ansari & Verma, 2017).

Legislative regulation of satellite navigation exhibits significant variability across different countries. Therefore, a detailed analysis of these regulations within specific national contexts is essential to fully comprehend the intricacies of the global navigation system.

Ukraine, as a proactive member of the GNSS community, maintains a robust network of GNSS observations. This network is vital for the country's cartography, geodesy, and navigation systems and underscores the significance of advancing indigenous space technologies and navigation systems.

A landmark in Ukraine's space endeavors was the launch of the "Sitch-2-30" satellite for Earth remote sensing on January 14, 2022. This event marked not only a technological milestone for Ukraine but also a significant contribution to the global navigation system (Nesterenko et al., 2021).

Consequently, this article centers on Ukraine, a nation with immense potential and aspirations in the space sector, albeit influenced by a complex historical and political landscape. These factors notably impact the evolution of its space legislation.

This research aims to dissect the evolution of Ukrainian legislation in the realm of satellite navigation, identifying pivotal challenges and opportunities within this domain, as well as evaluating Ukraine's position in the global space industry context. This analysis is intended to not only shed light on the specifics of Ukrainian satellite navigation legislation but also to highlight the significance of national contexts in shaping policies that bear implications for global space activities and security.

Historical Context

The evolution of space law in Ukraine, a pivotal chapter in the annals of aerospace jurisprudence, commenced in the second half of the 20th century when Ukraine was part of the Soviet Union. The genesis of Ukraine's practical space endeavors dates to 1951 with the establishment of a ballistic missile production facility in Dnipropetrovsk, initially known as "plant 586". This seminal facility underwent a transformation to become Pivdenmash. In 1954, Mikhail Yangel, a luminary in Soviet aviation engineering and a staunch advocate of storable propellant technology repurposed a division of this plant into an independent design bureau, designated OKB-586. This marked a significant departure from the prevailing preference for cryogenic propellants by Sergei Korolev at OKB-1 (later RKK Energiya), heralding a new era in space propulsion technology. The establishment of the Special Design Bureau 586, subsequently known as "Pivdenne (Southern)" and later as the Southern Design Bureau (KB Pivdenne), represented a milestone in the Soviet Union's space-related endeavours.

Dnipropetrovsk emerged as a linchpin in this development, hosting what was arguably the largest missile production entity in the Soviet Union and perhaps globally. Known as Yuzhmash ('Southern Machine-Building Factory') and later translated into Ukrainian as Pivdenmash, this entity housed a major design bureau, an R&D colossus that designed a majority of the Soviet ICBMs, including formidable systems like the "heavy" SS-18 and the solid-fuel railroad-mobile SS-24 (Nuclear, 2013).

The historic launch of the first Soviet artificial Earth satellite on October 4, 1957, signified a watershed moment in the annals of the space age, profoundly impacting both the USSR and the international community. This event precipitated a series of resolutions by the USSR's Council of Ministers, notably in March 1958, mandating OKB-1 under Serhiy Korolev to develop an array of spacecraft, including automatic lunar stations. Subsequent resolutions, particularly in September of that year, and the Soviet Council of Ministers Resolution No. 569-264 in May 1959, "On the preparation of humans for space flights," catalyzed the rapid advancement of the space industry, primarily within the USSR's technologically advanced republics.

Pivdenmash, later renamed the Southern Machine-Building Plant and eventually the Southern Machine-Building Production Union, or Yuzhmash (Ukraine), concentrated its efforts on the design and production of ballistic missiles, yielding a pantheon of significant systems such as the R-5M, R-12 Dvina, R-14 Chusovaya, R-16, R-36, MR-UR-100 Sotka, and the R-36M. During the zenith of the Soviet era, this plant boasted the capability to produce up to 120 ICBMs annually. By the late 1980s, it was designated as the primary manufacturing site for the RT-2PM2 Topol-M ICBM.

In the nascent years of the 1960s, Ukrainian organisations, including Pivdenmash, redoubled their efforts in developing and manufacturing sophisticated control systems, onboard automation, and other pivotal components for space apparatuses and complexes. Projects like “The Meteor” and “Arrow” are examples of how the “Southern” design bureau set out on a mission to incorporate cutting-edge technologies into spacecraft production. This period, extending from the 1960s to the 1980s, saw Ukrainian scientists and enterprises actively participating in an array of projects, spanning interplanetary station launches, manned space missions, unmanned spacecraft docking, and the construction of orbital stations (Okladna & Korchevska, 2021).

In a strategic move in 1960, the Soviet Council of Ministers promulgated a resolution “On the participation of the USSR in international organisations for the use of space for peaceful purposes.” This resolution defined the USSR’s and by extension Ukraine’s, engagement in international space activities. As an independent entity under the Space Treaty, the USSR, and subsequently, Ukraine, engaged with a multitude of international organizations, signing treaties and agreements that significantly contributed to the exploration and utilization of outer space (Okladna & Korchevska, 2021).

Post-Soviet Period and First Steps in Legislative Regulation (1991-2000s)

With the dissolution of the USSR, Ukraine inherited a substantial portion of the Soviet space infrastructure and technological assets. The nascent years of Ukraine’s independence were pivotal, marked by the formulation of a legal framework to underpin the burgeoning space industry. This era witnessed the development and implementation of legislation setting forth guidelines and standards for space activities, alongside the establishment of regulatory bodies. This juncture was instrumental in charting the trajectory of Ukraine’s autonomous space program, positioning the country as a full-fledged participant in international space law. The overarching objective transcended mere conservation of existing capabilities; it necessitated adapting them to the emerging political landscape, encompassing the revamping of erstwhile Soviet space programs and infrastructure, and instituting national entities to oversee space activities.

However, the legislative progression in space-related matters encountered hurdles, primarily due to economic challenges post-USSR disintegration. This period was characterized by rampant inflation, culminating in hyperinflation, the disintegration of long-established production networks, dwindling state budget revenues, and economic stagnation, all of which profoundly impacted state functions. A significant turnaround occurred in September 1996 with the adoption of the hryvnia currency, which played a crucial role in curbing inflation. The ensuing economic stabilization catalyzed a resurgence in the economy, bolstering budgetary allocations and fostering a conducive environment for investments in the space sector. Consequently, Ukraine began to enhance its engagement in international space endeavors (Okladna & Korchevska, 2021).

The establishment of the National Space Agency of Ukraine (NSAU) in 1992, through a Presidential Decree, was a strategic milestone in affirming the autonomy and developmental prospects of Ukraine's space industry's scientific, technical, and production potential. This decision aimed at the preservation and efficacious utilization of this potential to address socio-economic challenges within the country.

Endowed with a broad spectrum of responsibilities in the realm of space research and utilization, the NSAU undertook the formulation of conceptual state policy tenets in space research, proffering recommendations to senior state authorities, orchestrating the coordination of diverse institutions and organizations in the space sector, and spearheading international collaborations. These responsibilities spanned an extensive array of activities related to the exploration and utilization of outer space (On the Establishment, 1992).

The 1992 Presidential Decree was a foundational step in delineating the core principles and strategic directions for Ukraine's space industry. This directive also secured funding for research and development in this domain. A crucial facet of this era was Ukraine's integration into international space organizations, significantly bolstering the country's space industry.

The enactment of the Law of Ukraine "On Space Activities" subsequent to the creation of the NSAU established a comprehensive legal framework governing space activities within and beyond Ukraine. This legislation emerged as the cornerstone document defining the legal underpinnings of all facets of space activities, aligning them with both national and international norms and standards (On Space, 1996).

The Law on Space Activities provides an expansive legal scaffold for various aspects of space exploration and utilization, encompassing the legal oversight of the development, application, and management of space technologies and infrastructure, including satellite navigation. Although specific provisions dedicated to satellite navigation are in the nascent stages of implementation, the law's promulgation has laid a robust foundation for the ongoing evolution of space activities in Ukraine.

The Beginning of the 2000s and the Integration of Ukraine into European and Global Space Programmes

At the dawn of the 21st century, Ukraine embarked on a proactive journey towards integrating into European and global space programmes. This era was marked by the country's concerted efforts in the advancement of its space industry and the harmonization of national legislation with international standards. The collaboration with the European Space Agency (ESA) and participation in various international agreements were pivotal in this transformation.

The 2008 agreement between the Government of Ukraine and the European Space Agency heralded a significant phase in cooperative endeavors in satellite navigation, among other areas. Although this agreement was discontinued in 2019, its impact on the legal and operational frameworks of joint projects in space science, telecommunications, and satellite navigation was profound. Article 2 of this agreement underscored satellite navigation as a principal area of collaboration, encompassing the development and application of telecommunications technologies. The agreement facilitated an array of cooperative ventures including information exchange, joint research, and technology development, pivotal for the advancement of satellite navigation in Ukraine and its assimilation into European space initiatives (On Cooperation, 2008).

Another critical milestone was the Agreement on Cooperation in the Field of Civil Global Navigation Satellite System (GNSS) with the European Community and its Member States. Signed in December 2005 and ratified by Ukraine in January 2007, this agreement became effective for Ukraine in December 2013. It encompassed comprehensive cooperation in GNSS technologies, aligning with global navigation networks, fostering innovation, developing regulatory and legal frameworks, facilitating Ukrainian companies' access to the market, ensuring security, and promoting skill development through training programmes. This agreement laid the groundwork for Ukraine's integration into the European GNSS system, thereby significantly contributing to the nation's technological prowess and economic expansion (Agreement, 2007).

The 2010s: Innovation and Development in Satellite Navigation

During the 2010s, Ukraine embarked on a concerted effort to incorporate state-of-the-art technologies in the space industry, particularly in the domain of satellite navigation. A landmark development was the designation of the National Space Agency by the Cabinet of Ministers of Ukraine (Some, 2009) as the specialized entity responsible for coordinating satellite navigation and international cooperation. This agency was charged with the development of legislative drafts to regulate satellite navigation and to certify coordinate-time and navigation systems utilizing global navigational systems. Ambitious pilot projects aimed at deploying satellite navigation technologies across various sectors, including industry, transport, communications, healthcare, and ecology, were slated for commencement in 2012 (Some, 2009).

A significant legislative stride in regulating satellite navigation was taken in early 2013. The Cabinet of Ministers of Ukraine approved the concept of the draft law "On State Regulation in the Sphere of Satellite Navigation" (On Approval, 2013). This foundational document outlined the prevalent challenges and proposed legislative solutions, encompassing aspects such as public procurement organization, national production support, producer responsibility regulation, global navigation systems' safety, cutting-edge technology adoption, and national standards development. The concept aimed to establish legal, economic, organizational, and financial principles in this sphere, reflecting the increasing practical applications of global navigation systems in diverse areas, including defense and state security. Anticipated outcomes included the stimulation of the domestic navigation services market, technological advancements in science-intensive sectors, job creation, and enhanced public access to high-quality services and products through the utilization of modern domestic satellite navigation equipment (On Approval, 2013).

In 2013, the draft law "On State Regulation in the Sphere of Satellite Navigation" was formulated, seeking to establish a robust legal framework to foster the efficient use and growth of this sector (Draft Law, 2013). However, the failure to enact this draft law has raised concerns about the efficacy of state policy in this arena. The absence of this legislation leaves a significant portion of satellite navigation-related issues without proper legal oversight, thereby hindering the development and global integration of Ukraine's satellite navigation capabilities.

Overview of the 2016 Ukrainian Draft Law on State Regulation in Satellite Navigation

In 2016, amidst an escalating focus on regulatory measures within the satellite navigation sector, Ukraine grappled with the pivotal challenge of implementing the Draft Law “On State Regulation in the Sphere of Satellite Navigation” (Draft Law, 2016). This Draft Law represented a significant effort to forge a comprehensive legal, economic, and technical scaffold for fostering the development and efficient regulation of the satellite navigation sector.

Key facets of the law encompassed:

State Regulation: The Draft Law aimed to establish a cohesive state policy supporting satellite navigation activities, optimizing the utilization of scientific and technical resources for the national economy, defense, security, and social welfare. This initiative sought to harmonize state policy with the intricate dynamics of satellite navigation, underscoring the need for a unified approach to leverage this technology’s potential.

Established Directions of State Policy and Activities: The Draft Law set out specific conditions for the development of equipment related to co-navigation production. Emphasis was placed on fostering national technologies that provide support and economic advantages, aligning with existing security policies. A critical aspect was the safeguarding of information resources in line with current state policies. This approach was designed to nurture a sustainable ecosystem for satellite navigation, encompassing technological innovation, economic viability, and security considerations.

The 2016 Draft Law thus proposed a paradigm shift in the strategic management and regulation of Ukraine’s satellite navigation sector. By aligning state policy with the nuanced requirements of this high-tech field, the law sought to position Ukraine at the forefront of global satellite navigation development, leveraging it for enhanced economic growth, national security, and societal benefit.

2019: A New Phase of Legislative Reform in Satellite Navigation

In 2019, Ukraine embarked on a critical phase of legislative reform in the field of satellite navigation with the development of Draft Law No. 10198. This initiative signified a significant advancement from the foundational regulatory framework established by the 2016 Draft Law (Draft Law, 2019). The revised Draft Law introduced several innovative provisions aimed at establishing a comprehensive legal, economic, organizational, and financial groundwork for managing satellite navigation activities. Key features of the 2019 Draft Law encompassed:

Legislative Definition of Public Policy Principles: The law proposed the establishment of a cohesive public policy in satellite navigation, tailored to the needs of the national economy, defense, and security sectors.

Distribution of Powers Between Authorities: It emphasized the unity of rules and activities through the delineation of authority among ministries and central executive bodies.

Program-Target Planning: The law advocated for the implementation of program-target planning for satellite navigation activities within the ambit of state scientific and technical programs.

Harmonization with International Norms: A crucial aspect was ensuring the compatibility of activity regulations with international standards, facilitating Ukraine’s integration into the global space context.

Draft Law No. 10198 of 2019 represented a pivotal step towards crafting a holistic and harmonized legislative environment conducive to the development of satellite navigation in Ukraine. It mirrored global trends and demands, steering the country towards technological innovation and progressive development in this vital sector.

Further advancing the legislative framework, in 2021, the Ministry of Strategic Industries of Ukraine initiated the development of a new draft Act “On State Regulation of Satellite Navigation.” This initiative was part of a comprehensive government plan to implement various actions, including task 130 of the 2021 Government Priority Action Plan, task 52 of the Legislative Work Plan of the Verkhovna Rada of Ukraine for 2021, and article 371 of the Association Agreement between Ukraine, the European Union, the European Atomic Energy Community, and their Member States. These efforts were aligned with broader strategic objectives, as outlined in various government decrees and resolutions.

The 2021 Draft Law introduced adjustments in definitions and management structures compared to its 2019 predecessor. Notably, it updated the roles of industry and state registrars and the framework of the state satellite navigation system. These modifications aimed to clarify administrative responsibilities and enhance the organizational architecture, thereby ensuring efficient regulation and growth of satellite navigation in Ukraine. This legislative evolution exemplifies the government’s systematic and consistent approach to fostering this technologically critical sector, aligning with current international requirements and global trends.

Comparative Analysis of Draft Laws 2021 and 2019 regarding Satellite Navigation

A critical examination of the 2021 and 2019 Draft Laws in satellite navigation reveals several noteworthy amendments indicative of the progressive maturation of Ukrainian legislation in this domain.

Terminology Changes: Article 1 of the Draft Laws exhibits terminological variances. The 2021 Draft Law redefines industry and state registrars as personnel in employment relations with government entities, contrasting with the 2019 version that aligned these roles with the central executive body. This shift signifies a nuanced approach to the roles and responsibilities within the satellite navigation management system.

Legislative Regulation Expansion: The 2021 Draft Law broadens the scope of international agreements and domestic laws governing satellite navigation. This expanded regulatory framework accommodates the industry’s diversity and dynamism, diverging from the 2019 Draft Law’s narrower focus on the GNSS Agreement.

Diverse State Regulation Objectives: The 2021 Draft Law, in Article 3, delineates a comprehensive array of state regulation objectives, encompassing economic, defense, security, and social dimensions. This contrasts with the 2019 version, which primarily focused on the coordination of unified state policy implementation, indicating a more holistic approach to sector development and regulation.

Enhanced Allocation of Powers: Article 4 of the 2021 Draft Law augments the Cabinet of Ministers of Ukraine’s responsibilities, incorporating satellite navigation into state programs and assigning specific duties to the central executive body, such as coordination and international cooperation.

Expanded Scope of Activity: Both Draft Laws in Article 5 characterize satellite navigation activities as encompassing system usage, scientific research, monitoring, and equipment

development. The 2021 Draft Law, however, provides a more detailed delineation, reflecting the sector's increasing specialization.

Elevated Role of Security Service: The 2021 Draft Law's inclusion of the Security Service of Ukraine in decision-making on restrictions underscores a heightened focus on national security, recognizing the necessity of a comprehensive security strategy in the face of global challenges.

Local Government Involvement: The 2021 Draft Law emphasizes the role of local governments in developing and overseeing navigation systems, a departure from the 2019 law which primarily entrusted these tasks to executive authorities. This change underscores the significance of decentralized governance in satellite navigation, enhancing responsiveness to local needs and the versatility of satellite technologies.

Collectively, these Draft Laws mirror Ukraine's commitment to refining its legislative framework to align with contemporary demands and realities. They underscore the nation's ambition to not only incorporate cutting-edge technologies but also to cultivate a suitable legal and organizational ecosystem for their efficacious utilization. These legislative advancements represent pivotal strides in bolstering national security, fostering local governance, and propelling Ukraine's integration into the global space arena.

Development of Legal Regulation in Satellite Navigation in Ukraine: Presidential Decree No. 884/2022

Presidential Decree No. 884/2022, issued on December 23, 2022, represents a significant milestone in the evolution of legal regulation in the sphere of satellite navigation in Ukraine (On the Decision, 2022). This decree articulates the legal basis for the decision of the National Security and Defence Council of Ukraine, titled "On measures for the development and use of domestic satellite navigation systems in the interests of the security and defense of the state" (On measures, 2022).

The decision encapsulates a strategic response to the multifaceted challenges confronting Ukraine in satellite navigation. It addresses the imperative for effective systemic state regulation, the rectification of existing regulatory framework deficiencies, and the establishment of oversight and control mechanisms for domestic functional extensions to global navigation systems.

A pivotal outcome of this decision is the directive to the Cabinet of Ministers of Ukraine to formulate and submit the Draft Law "On State Regulation in the Sphere of Satellite Navigation." This Draft Law, conceived in reaction to contemporary challenges and threats, envisages a structured and regulated approach to the development and utilization of satellite technologies by the state. It entails introducing an unambiguous legal framework governing satellite navigation activities, fostering technological advancement, ensuring national security, and augmenting the country's defense capabilities. The overarching goal of this Draft Law is not merely the promulgation of new norms and standards but also the enhancement of domestic satellite systems, their amalgamation with international networks, and the facilitation of their efficacious application across diverse sectors, ranging from defense to civilian utilities.

In the context of Ukraine's current geopolitical and security landscape, marked by military conflict and external threats, the refinement of legal regulation in satellite navigation is of paramount importance. Satellite navigation systems are integral to national security and defense, underscoring the necessity for Ukraine to ensure resilience and self-reliance in this domain.

Presidential Decree No. 884/2022, alongside related legislative initiatives, mirrors Ukraine's strategic intent to bolster its defense posture through the advancement of indigenous satellite

technologies. This underscores the criticality of autonomy and self-sufficiency in satellite navigation, particularly in reducing reliance on external systems during exigent circumstances.

The decision to amplify the involvement of the Security Service of Ukraine in regulatory processes within satellite navigation and to empower local authorities in the development and surveillance of navigation systems signifies a recognition of the need for a holistic and multi-tiered approach to this issue. Such coordination among various levels of governance and agencies enables a more effective response to threats, ensuring alignment and expeditious action in crisis situations.

These legislative developments not only fortify the country's security and defense capabilities but also lay the groundwork for technological progress, enhance Ukraine's international competitiveness, and unlock new prospects for the civilian sector. This is particularly pertinent in the face of modern challenges where satellite technology plays a crucial role across a spectrum of applications, from defense to agriculture, infrastructure development to emergency management.

Development of the legislation of Ukraine in the sphere of satellite navigation in 2023

In March 2023, in response to the decision of the National Security and Defence Council of Ukraine of December 23, 2022, the draft Law of Ukraine 'On State Regulation in the Sphere of Satellite Navigation' was published. This decision was put into effect by Presidential Decree No. 884/2022 and became part of Step 203 of the Priority Action Plan of the Government of Ukraine for 2023, approved by the Cabinet of Ministers of Ukraine Decree of 14 March 2023 No. 221-p. It also corresponds to task 150 of the Plan of draft work of the Verkhovna Rada of Ukraine for 2023 approved by Resolution No. 2910-IX of 7 February 2023, as well as to article 371 of the Association Agreement between Ukraine and the European Union, the European Atomic Energy Community, and their Member States, and the task 1896 of the plan of measures for the implementation of this agreement approved with the Resolution of the Cabinet of Ministers of Ukraine of 25 October 2017 No. 1106, following paragraph 2 of the Order of the cabinet of ministers of 3 January 2013 No. 1-r "On approval of the Concept of the draft Law of Ukraine "On State Regulation in the Sphere of Satellite Navigation."

The Draft Law 2023 and its differences from the Draft Law 2021 The Draft Law 2023 is today a key document that reflects the strategic vision of Ukraine in the field of satellite navigation, emphasizing the need to develop its technologies and systems. The Draft Law also emphasizes the importance of international cooperation and integration of Ukraine in global space initiatives, which opens new prospects for the country in international space programmes and projects. Such cooperation has the potential to contribute to better use of satellite technologies, development of scientific research, and technological progress. Particular attention in this draft law is paid to ensuring national security and enhancing the technological potential of Ukraine in the context of the global space community.

A detailed analysis of the 2023 Draft Law compared to the previous version (the 2021 Draft Law) reveals the following key aspects: Basics of public policy and rules of activity: The basic principles of state policy in the field of satellite navigation and the rules of activity in this field are defined. This creates a clear framework for the development and regulation of satellite navigation in the country.

Powers between State Authorities: The powers between the various state authorities in the implementation of state policy in the sphere of satellite navigation, which ensures coordination and efficiency in the management of this sphere, are determined.

Component activities and conditions of restriction: It establishes components of activities in the field of satellite navigation and conditions for limiting such activities, which are important for national security and defence.

Terms of provision and use of services: The terms of provision and use of satellite navigation information services are regulated, ensuring their availability and quality.

Registration of functional add-ons and information systems: Procedures for registration of functional add-ons and navigation information systems are defined, which facilitates their effective use and control.

The 2023 Draft Law marks several key updates and differences compared to the 2021 Draft Law, which indicates the strategic development in the field of satellite navigation in Ukraine: **Changes in funding:** The new Draft Law introduces more flexible and diverse financing mechanisms, including public-private partnership, own funds of navigation entities, and attracting foreign capital. This expands the opportunities for the development of the sector.

A more structured and comprehensive approach: The 2023 Draft Law proposes a more detailed and inclusive approach, including enhanced definitions and terms, which contributes to clarity in the regulation of activities in the field.

Renewal of powers of state bodies: In 2023, more attention is paid to the distribution and specification of functions and powers between the various government bodies, ensuring effective coordination and clarity in the decision-making process.

Special regime in times of war: The draft law introduces special provisions for working in times of war and emergencies, reflecting the need to adapt to changing conditions and ensure national security.

General modernization and adaptation to contemporary challenges: The 2023 Draft Law demonstrates the overall trend of updating and modernizing Ukrainian legislation in the sphere of space activities and satellite navigation, making it more adapted to modern technological, economic, and security challenges.

Therefore, it is advisable to note that the Draft Law 2023 reflects a comprehensive and flexible approach to the financing of the sphere of satellite navigation, offering various sources of financing. These innovations adapt Ukrainian legislation to modern challenges, providing flexibility and stability in the development of satellite navigation.

Conclusions

This article offers an in-depth exploration of the evolution and future trajectory of satellite navigation in Ukraine, underscoring the pivotal role of national legislation, particularly in the backdrop of the ongoing conflict in the country. By examining both historical and contemporary facets of Global Navigation Satellite System (GNSS) development in Ukraine, the article highlights the critical importance of technological innovations, international collaboration, and Ukraine's contribution to global space initiatives.

A focal point of this analysis is the 2023 bill "On State Regulation in the Sphere of Satellite Navigation." This legislation emerges as a cornerstone in bolstering national security and harnessing satellite technologies for defense and intelligence operations. It is instrumental in ensuring the dependability of communications, navigation, and surveillance, especially under

wartime conditions. The bill also underscores the necessity of a holistic approach to regulating the satellite navigation sector.

To forge ahead in this field, Ukraine needs to fortify its regulatory and legal infrastructure, enhance the expertise of professionals in the sector, and foster effective synergy between government bodies and the private sector. The future of satellite navigation in Ukraine hinges on its agility to adapt to rapid industrial transformations and to seamlessly integrate into the global space market. The concerted efforts in these areas will not only strengthen Ukraine's position in satellite navigation but also contribute significantly to its technological sovereignty and economic resilience.

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Beyond Borders: Crafting a Cosmic Jurisprudence for Space Exploration

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This article explores the intersection of philosophical and social concepts with space law, examining their practical implications and relevance to contemporary challenges in space activities. The narrative begins by emphasizing the significance of realization in cultural execution, underscoring the importance of balance and moderation as cultural values. The discourse then transitions to the realm of space law, posing critical questions about the goals, decision-making processes, and the overall horizon of space exploration. The text evaluates the existence and impact of “soft” and “hard” laws, asserting that the effectiveness of laws lies in their impact on opportunity horizons. The role of a space lawyer is contemplated, focusing on the bridging of the gap between present realities and aspirational futures guided by relevant mythologies and ideologies. The narrative concludes with a call for a psychological understanding to accompany legal structures, asserting that laws for space activities must align with foundational cultural elements to be effective. The emphasis of the article’s exploration of space law within the broader context of philosophy and culture, calls for the need of an interdisciplinary approach to address the complexities of space activities.

Keywords: mythological narratives, ecological perspective, space law paradigm, space ideology, logos, mithras, space exploration, transjective, legal philosophy, opportunity horizon.

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Introduction

“Space: the final frontier. These are the voyages of the starship Enterprise. Its five-year mission: to explore strange new worlds; to seek out new life and new civilizations; to boldly go where no man has gone before!” The first law in the code of Starfleet command is about non-interference with poorly developed civilisations. As a clear example of a space law, it has profound philosophical and practical implications. We do not know where do we come from, what

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is our purpose and where do we go for the horizon is ever expanding and cooling and our fears of the unknown are evergrowing and everlasting. Thus, our desire to codify them in a reasonable rule book. Rule books have been our guide for thousands of years. Many speak on what is the meaning of life? While most epistemological discussions revolve around “what could it be?” The space law is not just any other law nor it can be a simple offshoot of existing understanding of what law must perform and look like. This is a law at the edge of human understanding and as such cannot be conceptual, it must be descriptive at best or handicap possible outcomes as an alternative, which would consecutively lead to conflict in order to resolve the impasse.

One has to discover a healthy balance of the practical and theoretical and that is achieved at the very basis – ecology. We have to grind our trite and overly complicated sense of understanding of reality to the finest detail where it still didn’t lose its contextual meaning. Where agent-arena relationship (Vervaeke et al., 2012) is maintained to be able to answer that question at its core and give an answer – survival. This is what space law has to be about. How else can you codify poorly understood? Only by turning those laws into an empty shell devoid of any meaning for laws are to capture what has become concrete and there is no understanding of what is concrete. Robert Heinlein once said that violence is the prime hierarchy for all of other hierarchies and that was almost true, it was least incomplete than most of other works of academic and artistic nature of its time, asserting metaphysical basics in most concrete way. We exist in a state of uncertainty, from most physical level of processes (Ulanowicz, 2009:110) of finding out tomorrow that your DNA made a mistake few months ago to most abstract consequences of our decisions in few days, weeks or decades. This makes questions like: “what would you do if you knew you couldn’t fail?” so appealing that some decide to put it into laws today, before any such endeavour materialised. How to prevent such blatant mistake? To paraphrase Moltke: Rules are long term plans that will not survive the impact with the enemy, so know thy enemy beforehand (Sun, 2020:13).

We have to go all the way back to source of our motivation as a group and as individuals – survival. To begin understanding the role of space law one has to revisit survival and how space is vital to its manifestation. We orient our uncertain far future opportunity horizons through our remote past history. And thus, in this uncertainty, we, as an organism, be it simulated reality or not, exist in an ecological dimension, perhaps the most purposeful one. Our existence as a living organism is limited to three acts: moving, adapting or dying. This much I propose we are bound by three prime hierarchies: violence, information and wealth. Nobody is beyond it but supreme beings of various fashion. It doesn’t matter that human psyche cannot falsify itself, as long as we do not descend into madness of the unstructured, we retain a modicum of civilised coherence of our worldviews and ignore the loopholes. This is the knowledge source, the Agrippa’s trilemma which is neither a trilemma nor a conflict. The three types of knowledge codification are complementary and have their psychological age. Consider dimensions of time and space we inhabit and explore by moving around space and along time. If we cannot move, we remain relatively static but we adapt, and if we cannot adapt, we move, or if neither – die. These are our processes and they are inescapable. All other human processes are bound by these three just as by prime hierarchies which I propose to be cumulatively exhaustive and interdependent.

We can clearly see those explorations of any kind, from a start-up funding runway to an imperial expedition to the far reaches of the empire to acquiring a new skill for yourself last roughly up to two years. Public budgeting is yearly, longer planning is harder the more complex your organisation is, which is why big corporations just as empires/superpowers inevitably perish. Most fail to adapt which is why they perish. Adaptation takes time to learn and is a time

dimension process, as exploration is a space dimension process which requires motion. Thus, we can consider that adaptation is relatively space-blind and exploration is relatively time blind. So are the cultures that employ one or the other as the predominant modicum of being in the environment. Former happens in the future and the latter in the now. Death being human event horizon, socially or individually. In presence of such obligations, we articulated the process of creation long time ago, notable content examples for European cultures, in word – logos, in agreement with ourselves and others – mithras. To remind ourselves about agreement with gods we put our golden circle, a contractual binder, on the head of the saints and the kings, the halo and the crown, the supranatural source of law and order in society. This is a cultural demonstration of understanding and acceptance of connection between mythohistorical layer of the society with the legitimacy of the rulers and their present legalism. Our mythologies are born and live through these processes to help us narrate the world. The first laws, rules and regulations of their kind as a form of articulated and codified reality. The proto-legalism imbued into the mythological.

What is that which does not need to move, adapt or die? How would it look like? Not like us. How do we make ourselves look like it? Where would it come from? Not here. Then we have to go to “not here”? How do we get there? How would it behave? Not like us. Then we have to behave like it. When do we go? As soon as possible. What do we need to get there? Become more like it. If it needs not to move, how then? When it is everywhere at once. And then it needs not to adapt? When it already knows everything. If it never dies? Then it ever lives for all time forever. In space and time in everything. Syntropy and entropy. Solve et coagula. Bigger than biggest and smaller than smallest. Alpha and omega. Context is same, content is different and for this reason good and bad, evil and grace do not exist. So, how does one codify such vagueness? This is the primary goal of law; to constrain vagueness in a coherent fashion. In face of such context, space law is not only divorced from the mythological but also does not narrate that which is least incomplete. It is too limiting; as Piaget mentions: the learning process is a balance between compressing the information and incorporating wider understanding when the conceptualisation becomes a limiting factor. Thus, certain mythologies have space exploration as their horizon and some do not. What makes space law legitimate for some and not for others? This is the question that leads various agents in the arena to have a hard law and a soft law separation as a middle-of-the-road solution to the complexity which lawmakers are not equipped to mediate. Thus, the mithras, the agreement, is weak in the transjective sense (Vervaeke et al., 2012) as its perception as illegitimate is sensed, consciously or unconsciously, by certain agents. The transjective fabric of the ecosystem enabled by the space law is radicalised through poorly codified legitimacy in the narration of the law.

In this regard current space law has nothing to do with space as space is poorly understood from the conditions of survival processes. It is understood from conditions of survival processes on earth only and is a mere extension of them where survival in its earthly sense becomes quite impossible. For simple fact that it is an inhospitable environment. Most of law is binding processes which are dictated by environment. Thus, even space law is oriented towards earth. Which processes are dictated by space? Environment for moving or adapting is not present, however environment for dying is excellent: extreme temperature, lack of gravity to move and lack of resources to adapt. Does space law primarily deal with death and death related activities? Does one need a death cult to successfully orient in space? No. Therefore it is not space law but an earth law about space. Its structure is about what would happen on earth if X would happen in space. Just as everything that is poorly articulated, if a selected mythology does not articulate

death well, then it will not be able to accommodate legal system that codifies it. Much less a mythology that avoids complexity of death and its relationship to adaptation and exploration. As such space law in its present form, in international context, does not exist. It is separate from mythologies that encompass space/other worlds exploration as its horizon, which would involve moving and adapting as well as dying. It is separate from multiplanetary existence. It is separate from mythological horizon that leads to such conceptions as galactic propagation. Instead, it is a rudimentary body of poorly related works that have not been adapted to the shift in the context of international relations since the early days of the First Cold War and continued with the Second Cold War commencing in 2008 with the NATO summit in Bucharest and subsequent Russo Georgian war in August that year (Mearsheimer, 2021).

Discussion

The law attempts at coherently organising human activities where death process reigns supreme and is primarily oriented at activities occurring on earth while space is a conditional to such activities. It is but an extension of a perception of what space law must be. It is limited in such form due to the simple fact that there have not been created works of ideological character that tie space capable mythologies with legal systems which would coordinate them in time and space. So, what would be prerequisites for such an ideology to emerge?

Two biggest types of cultures exist on earth: nomads and farmers. Two best survival strategies, exploratory adaptation and adaptive exploration. Death cults are short lived and therefore rare. Cultures solve that domain with transcendence tied to the other two strategies. In this regard space law as a death bound domain, a transcendent element of the international law. Successes are historically shown in form of empires of any shape or form from all corners of the planet. At the bottom of this lies mechanism older than our oldest stories – morality. Not a human construct but a biological reality we share with the rest of the animal kingdom. That of fairness, reciprocity, empathy and compassion (de Waal, 2010). Those who do not possess it are beyond the construct of good, therefore are regulated by our exhaustive, per our opinion, laws. The finite games (Carse, 2013) defined for the society to propagate itself, in the direction many think to be prudent. The imprudent shall be corrected in their course with violence (Heinlein, 1987); one of the prime hierarchies. All mythologies speak of ignorance, greed and hatred just as of understanding, generosity and love. There are rules to follow or be ready to be judged by the representative wielding the golden circle or by the supreme authority, which resides beyond confines of time, space and the need for resources. The contract with the opportunity horizon is the judge of the time, space and resource management; the energy allocation in the system.

There is a particular layer of the culture, where certain individuals exist. Not godlike but that of spirits and saints. The shamans of the tribe and the philosophers of the cave, the prophets of the congregation. Propagating ideologies that are born given the values extracted from the mythological stratos. For space, time and resources are organised in either centralised or decentralised fashion according to set of values we hold dear universally. The Mithraic context binds us together regardless our origins and points to the very limits of our existence. Scarcity, sacrifice and earning become lawful, while abundance, theft and giving become regulated to become lawful. Mithras cannot precede logos, so without mythology there can be no laws, no social contracts. Violation of this order leads to avoidance of said laws or their futility. Soft law. One can call them non-binding resolutions, codes of conduct and many more, and upon their violation everyone remains deeply concerned and carries on with their day. Soft law is not bound

to the prime hierarchies and for that reason is futile waste of resources, time, space and energy. On the contrary, the hard law, so-called treaties, are violence bound, wealth bound and data bound. Hard law is the law that respects the order of creation. Laws which ignore it historically have led to radical states of being which involved tremendous violence, abuse of wealth and time for those unwilling to accept that the creative order has been abused. Notably two authors remind us of this: "...then they came for me – and there was no one left to speak for me." – Niemöller and "Nothing is easier than stamping your foot and shouting: "That's mine!" It is immeasurably harder to proclaim: "You may live as you please."" (Solzhenitsyn, 2007). Invariably these states fail from within or from without due to the inevitability of conflict within or with other societies, to begin the process again. Pick your favourite dictatorship to fill in the blanks.

Eventually, we seek out a narrowing to the horizon of opportunities and that horizon is provided by the philosophies which extract the value out of moral mythos of one's culture. Hence, a law that attempts to be mythological puts ideologues and propagandists atop the graves of philosophers. However, that ideological narrowing captures our best attempt at finding optimal direction towards reaching the horizon given our limitations. We develop a set of systems to achieve a better understanding of how we are to achieve the horizon in a systemic fashion. This much the systems define paradigms after a set of understandings was developed, rather than forced. The conflict and the cooperation in both physical and mental space defines plausible set of finite and infinite games to achieve the results at hand. We box the concepts of mythos and ideas into digestible ready product packages that fit the market. Religion, politics, economics, military, academia, medicine, legal. We codify the network of interrelations of conflict and cooperation and we call it law. Law of all kinds; rules of the game (Carse, 2013).

All rules however follow and are limited to the four stages of negotiation. Persuasion, bargaining, violence and abstention (Walton & McKersie, 1965). We regulate these under the norms we subdivided into social and market (Ariely, 2010). We call those who operate only at two extremes of cooperation as radicals for they employ only persuasion or violence. Who does not negotiate with the terrorists? However, a child operates in all four dimensions and yet it is permissible, for the child is at the bottom of all three prime hierarchies and thus consequences of their actions are of little impact on lives of those with whom they explore the negotiation, the systems to which they pertain. The children are in the grey area between the hard law and the soft law. Entities can trade in pure market fashion or in pure social fashion. Nomads prioritise social relationships and thus concept of contractual obligation is ignored by concept of obligation to the person who is your relative, friend, or to whom you owe something in kind. Don't we all owe something to someone? On the other hand, some people do not care if you are their kin, they prefer contractual relation for it ignores social contract and enforces pure wealth hierarchy relationship. The mixture of market and social norms brings its negatives the likes of prenuptial agreement or offering monetary instead of in-kind rewards to your friends or family. Perhaps we could devise better systems but they are just a path that is defined in the narrowing of the ideology to which they pertain. Many rough moments of history emerge as we attempt to define ideas according to systems or mythologies according to ideologies, the smaller trying to become bigger will invariably fail. There is a period of hospitable frenzy before the instability of what has to be achieved emerges and becomes evidently unsustainable. The systems are in place to ensure the path is abided by the following generations without decay to the hierarchies. With passage of time it becomes impossible, as the lessons of previous generations are not transferred to the next which brings faulty execution. We of course devised methods that would allow systems to survive longer

than our inability to transfer the lessons learned from the environment. The methods are simplified direct ways of minimum effort to achieve maximum result in shortest period of time. However, it brings an error to the process, the structure becomes dogmatic and therefore more susceptible to entropy. On the other hand, keeping it flexible will allow unearned leaders to bend it to the times in which they exist, diluting the lessons learned with own genetic ignorance inherited from the ancestors. This is yet to be resolved and thus we would think that methodologies would provide solutions to such instability.

Teaching methods, working methods, praying methods, healing methods. What is the purpose of the methods? To define goals based on the purposes of the systems and ideological consideration as to what is the best direction to survive. To reach heavens, to become immortal. The evolution requires a path and methods are a discipline to the varied desires. Curtailing the inefficient and the impossible. It shaves off the unnecessary and takes away your freedoms by turning them into discipline. It is limiting as certain things cannot be done simultaneously and prioritisation takes place. This is what people who experience education system and its methods erroneously ascribe as detrimental. That it creates cogs in the machine. I ask you, how else one achieves goals without focusing everyone on those goals? As long as those goals serve the many it is more than beneficial to the many to have such methods in place. Once institutionalisation takes place (Quigley, 1961), then we can speak of detrimental degeneration of the social mechanisms. The degrees of freedom or degrees of discipline define how focused and collected you will become. How easy it would be to engage in both personal and social transformation. The priorities to be followed and devised. In the end that what defines the results we are to manifest in the world.

The need for infrastructure follows the survival strategies. The infrastructure is shaped by the previous layers and allows us to propagate ourselves physically in time and space with available resources. Be it an airplane or a fortepiano, a highway node or a cruise ship, they are either robust or efficient just as the two main survival strategies. The nomadic are quite robust but capped in growth and farmer are very efficient but tend to be brittle. In the end the infrastructure is subdivided into four categories of air, sea, land and space. The digital category is pervasive and is a combination of these, a transjective arena for infrastructure.

In the end the most vital stage at which action dominates and perception is formed is that of realisation of that which has to be achieved. The action is immediate and follows deadlines, be it slow or fast paced. It can be both an art and a science. Here, the crucial understanding is that of balance and moderation. For once we have a narrowing in the horizon and the direction has a clear path, and we possess formation of tools necessary to propagate us along that path of time and space. We have to retain a balanced approach to movement and adaptation in the execution of the culture.

Conclusion

One might ask what does this have to do with the space law or space activities in general? What is space exploration but not a horizon? How do you achieve the goals? What are the goals? How do we know what goals we must pursue? Who decides on those goals? What is the timeline and resources necessary to achieve it? Will it succeed? How do we not fall into the wishful thinking? Do we make laws that are descriptive or normative? Normative according to what? Will it work in the end? It is discussed now the existence of the soft and the hard law. There is no soft or hard law. There is law that everyone cares about because they do not want their

opportunity horizon limited and there are laws that nobody cares about because its existence is inconsequential to the activities of the agents in the arena. Therefore, descriptive laws become normative where it matters and normative laws become useless because they do not matter. The less contextually aware one of the mythological necessities the more wishful thinking and the more ineffective laws are drafted. One can argue the specificities of the definitions and the expertise on the subject and yet violence hierarchy says what it always did – “if I can, I will do what I want and no text on paper will stop me.” One can engage in mental gymnastics of Olympic standards to ensure that their worldview is retained intact for chaos is not one wishes to endure, however, those who do not adapt to what is, will remain as what once was, and what once was will be no more. One cannot simply decide to draft law and see what happens. It is too irresponsible on cultural level to perform such acts of barbarity. History is rife with examples when such was enacted and centuries of progress were wiped in conflict as a result.

What is the horizon for space activities? What mythologies define it and can encompass such horizon? What ideologies exist that allow for this? For if no ideologies exist then no political system, economic system or any other system for that matter is designed to accommodate such tasks and they will invariably fail regardless the laws you wish to propose or impose. Then, the work of space law begins with mythology that can elaborate the horizon. Then, one needs philosophers to narrow the horizon into an approximate direction and only then the time for systemats arrives to develop legal structures to narrate the limits of the finite games. Limits that have to be pragmatic, just as space and time invariably moves. Once you fail to move and adapt with it, so you begin the countdown to failure. Dogmatism, a low propensity to learn, ensures your invariable demise.

The implication for space law

Thus, what is the role of the space lawyer in today’s day and age? To bridge gap between what is and what ought to be? That is hardly codifiable. The work is to identify mythologies and to prospect philosophies which point to the stars, rather than down to earth and each other’s land. Almost all of space law is related to activities directed at earth for many of our mythologies have been abandoned by secular societies in the name of a fight against religious systems. Instead, confusing the mythological with the religious and thus introducing a handicap to learning. This turns ideologies into free roaming madness of petty men who wish to become the myths themselves whether consciously or unconsciously for we killed the god and wish to be in its stead (Nietzsche, 2011).

In this seemingly unsophisticated way, we must ensure that most of our actions are in line with our infrastructure, our methods and systems follow the ideology that orients us towards a future we envision. To be a space lawyer of today is to be a lawyer who wishes to work on space subjects rather than lawyer who needs space. The limitations are immense and potential hurdles to overcome are done by those who are yet to emerge and manifest the path. As much as laws for commercial space, space mining or space economy seem appealing, if psychological basis are not taken into consideration, it would either be incredibly destructive or have no effect whatsoever.

Considerations for future research

In this regard, most apt consideration is research into a synthesis of a space ideology. Given various mythologies worldwide, it will facilitate the emergence of the appropriate delineations

for space law and solidify its legitimacy through the connection between the logos and the mithras when it comes to the order of creation.

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Dark Sky Protection for Space Sustainability and Space Exploration

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Increased levels of artificial light at night (ALAN) have resulted in ground-based light pollution. The disappearance of the natural dark sky impacts various domains, including astronomy, environment, biodiversity, human health, energy efficiency, and climate. Concurrently, the recent influx of satellites into Earth's orbit compounds the issue, by introducing orbital light pollution and further compromising night-time visibility. This article briefly introduces the issue of light pollution and discusses the relationship between dark sky protection, the space environment, and the realm of space exploration. Recognizing the growing significance of preserving dark skies for different fields, the paper elucidates the important role of dark sky protection in ensuring space sustainability.

Keywords: dark sky protection, dark and quiet skies, light pollution, space sustainability, space environment.

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Introduction

Over the past decades, research has evident the adverse impacts of ground-based light pollution, ranging from the creation of obstacles for astronomical observations to negative effects on ecosystems, habitats, biodiversity, and human health (Rodrigo-Comino et al., 2023; Falchi et al., 2023b). This issue has recently been escalated by orbital light pollution created by a growing number of satellites in Earth's orbit (Falchi et al., 2023b). The increased brightness of the night sky, resulting from the interplay of ground-based and orbital light pollution, poses additional challenges, necessitating prompt action to preserve dark skies in both natural and space environments.

While the problem of ground-based light pollution has started to gain due attention in legal and political agendas, with several international and national regulatory frameworks

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adopting mitigation measures (Schroer et al., 2020; Yakushina 2022), orbital light pollution has only begun to receive recognition, and comprehensive regulatory measures are yet to be implemented. Therefore, drawing attention to the need to protect dark skies as an integral part of space sustainability is crucial for the prevention of further adverse consequences.

This article consists of six sections. The first section provides a brief introduction to the issue of light pollution by giving a light pollution definition and discussing its forms, sources, and impacts. The second section probes into the triggers which led to the adoption of light pollution regulations. The third section provides the results of my research on approaches to light pollution regulations worldwide. This section introduces the main areas where such regulations can be found. Section four discusses issues related to space sustainability and the protection of the space environment. The fifth section brings the value of the protection of the dark skies to the realm of space sustainability and future space exploration. Finally, the sixth section consolidates key insights, offering conclusive remarks and recommendations.

1. Light pollution: definition, forms, sources & impacts

Despite a lack of a uniform definition of light pollution, it can be defined as an environmental problem caused by increased, unwanted and misdirected artificial light at night (ALAN).

The commonly accepted forms of light pollution are:

1. *Light clutter*: bright and excessive groupings of light sources.
2. *Sky glow*: brightening of the night sky over inhabited areas.
3. *Light trespass*: light falling where it is not intended or needed.
4. *Glare*: excessive brightness which causes visual discomfort.

1.1. Sources of Light Pollution

Light pollution is caused by different sources of ALAN:

- *Outdoor lighting installations*, including streetlights, sports lighting, road lighting, advertisements, security lights, floodlights, etc.
- *Indoor lighting installations*, such as indoor illumination of glass offices or commercial buildings.
- *Satellites and mega-constellations of satellites*.

1.2. Light Pollution Impacts

Light pollution is a concern on many fronts, including:

1. *Dark skies*. Increased nighttime brightness creates obstacles for amateur and professional astronomical observations.
2. *Habitats*. Light pollution contributes to habitat fragmentation and can pose challenges for species' migration (Ditmer et al., 2021).
3. *Biodiversity*. While different species exhibit varied responses to increased nighttime illumination, light pollution has a significant impact on a diverse range of flora and fauna (European, 2023; Karan et al., 2023).
4. *Climate change and energy efficiency*. The use of ALAN contributes approximately to more than 38 TWh of energy use annually (Sánchez de Miguel, 2015; Sánchez de Miguel et al., 2021; Sánchez de Miguel et al., 2022).

5. *Human health.* Extended exposure to ALAN can result in both physical and mental health disorders in humans (Cupertino et al., 2023).
6. *Public and road safety.* Contrary to the common perception that ALAN enhances public and road safety, increased nighttime illumination has, in certain instances, been shown to either reduce safety levels or exhibit an inconclusive correlation (Fotios et al., 2021; Thompson et al., 2023). Nevertheless, the presence of ALAN does play a notable role in diminishing of “fear of crime” – the subjective sense of safety (Son et al., 2023).
7. *Culture and human rights.* The presence of dark skies always played a crucial role in shaping societies worldwide. Even now, numerous indigenous communities rely on dark skies for their cultural and traditional activities. Increased light pollution levels pose major hindrances to the performance of such activities (Hamacher, et al., 2020).

2. Triggers for Light Pollution Regulations

The analysis of regulatory approaches to light pollution mitigation worldwide has revealed that three main triggers have prompted the adoption of such measures:

- (1) energy efficiency concerns;
- (2) environmental concerns;
- and (3) the need for the protection of astronomical observations and future space exploration.

From the beginning of the 2022 energy crisis, numerous national and local governments implemented measures aimed at the reduction of outdoor ALAN for energy-saving purposes. Research indicates that over 600 local governments in Europe have implemented ALAN-reduction measures, including complete nighttime lighting switch-offs and/or curfews (Nachtabschaltung, 2023).

Another reason to adopt regulatory measures to address light pollution is environmental concerns associated with increased ALAN levels. These impacts were identified within a substantial body of research conducted in recent decades. Light pollution mitigation measures have become an integral part of environmental protection efforts in many countries (Croatian, 2019; Slovenian, 2007; German, 2021).

Finally, the necessity of ensuring astronomical observations for scientific purposes and future space exploration has also prompted national governments to take measures to reduce light pollution. Several countries have enacted laws aimed at protecting dark skies above major observatories (Spanish, 1988).

3. Legal Approaches to the Protection of Dark Skies

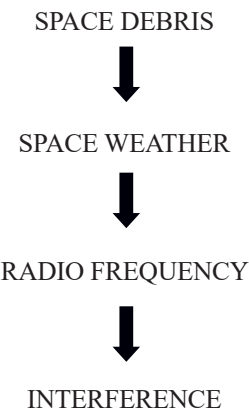
Light pollution is a complex phenomenon, and its consequences, as mentioned earlier, have wide-ranging adverse impacts across various domains. This complexity, in turn, creates difficulties in identifying legal and regulatory frameworks applicable to mitigating light pollution. The table below outlines the primary regulatory areas, which encompass measures for addressing and mitigating ALAN-related impacts adopted in different jurisdictions.

Table 1. Legal Approaches to Dark Sky Protection: Areas.

Area of implementation	ALAN-related Measures
Energy efficiency	Reduction of ALAN to save energy
Urban planning	The amount of light is indicated per urban zone (residential, commercial, etc.)
Environmental protection	Light pollution is recognised as an environmental pollution
Protection of astronomical observations	Established dark zones to protect the needed conditions for astronomical observation
Public procurement	Minimizing light emissions for future projects
Protection of indigenous communities	Protection of dark skies to allow traditional activities
Cultural heritage	Dark sky is considered the common heritage of humankind
Space sustainability	Impacts from space objects and space debris on dark skies should be reduced and mitigated
Dark sky protection and/or light pollution mitigation regulations	Specifically address various impacts of light pollution and impose measures for ALAN reduction

4. Space Sustainability and Protection of the Space Environment

Similar to light pollution, there is no universally accepted definition of space sustainability. The Secure World Foundation (SWF) defines space sustainability as the ability of all humanity to continue to use outer space for peaceful purposes and socioeconomic benefit over the long term (Secure, 2018). This definition includes the following aspects of sustainability:



The provided definition, however, lacks specific consideration of environmental concerns associated with space activities. Expanding on this, the concept of space sustainability can also be examined through the framework of “sustainability,” derived from the principles of “sustainable development” endorsed by the United Nations (UN) (Transforming, 2015). The latter encompasses three primary dimensions: social, economic, and environmental. In this context, a more comprehensive interpretation of space sustainability will include:

- Social development: scientific research and astronomical observations
- Economic development: future space exploration
- Environmental protection: protection of both outer space and Earth’s natural environment.

Table 2. Interplay between Ground-Based and Orbital Light Pollution.

Ground-Based Light Pollution	Orbital Light Pollution
Disappearance of dark skies	Disappearance of dark skies: illumination and space debris
Inability to explore outer space and obstacles for astronomical observations	Disruption of astronomical observations
Environmental impacts	Additional environmental impacts on the Earth’s natural environment
Reduction of proper guidance and management of space objects	Impacts on the outer space environment

Value of Dark Skies for Space Sustainability and Future Space Exploration

Incorporating additional considerations, such as the protection of dark skies, into the framework of space sustainability will result in:

- Overall improvement of space sustainability and advancement of the space sector
- Cultivation of a healthier outer space environment (protection of the space environment)
- Preservation of Earth’s natural environment
- Unrestricted opportunities for conducting astronomical observations and space exploration (scientific research, as well as the management and guidance of space objects)

Conclusions

This article has provided a brief overview of the issue of light pollution and contributed to a discussion on incorporating the protection of dark skies into the context of space sustainability. The research indicates a pressing need for the ongoing development of regulations aimed at mitigating both ground-based and orbital light pollution. To facilitate the implementation of protective measures and enhance the sustainability of space activities, it is essential to consider space as an integral component of the natural environment. This approach enables the application of environmental regulations to current and potential challenges. Legal recognition of light pollution as an environmental concern is crucial for implementing more stringent measures to reduce its impact.

Particular attention should be directed towards addressing issues related to orbital light pollution, which currently lacks adequate regulatory attention. Addressing this problem involves the mandatory inclusion of impact assessments for satellites and mega-constellations, considering potential impacts from reflective surfaces, such as solar panels. Additionally, new technological requirements for satellites and space objects must be introduced to minimize their impact on the visibility of dark skies (Gaston et al., 2023).

Furthermore, addressing light pollution issues requires comprehensive awareness campaigns and the involvement of various stakeholders from research, industry, and policymaking. Collaborative efforts are essential to bring about the necessary changes in practices and policies related to light pollution and ensure future space sustainability.

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**The editor-in-chief's welcome speech
to the participants of the International Conference
on "Space Security and Safety Dimensions."
Held at Space Park, Leicester, UK,
on September 28-29, 2023.**

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Long-Term Space Sustainability and Space Traffic Management are two highly complex and critical topics for the state of space environment issues that, for now, remain as mere concepts rather than real tools powered by global commitment and engagement fostering order, transparency, certainty and predictability of operations in space.

Who truly cares about these concepts? Who strives to shape an adequate legal enterprise where these concepts are operational, feasible, self-sufficient mechanisms, and fully enforceable for the purposes of accountability? It is unfortunate to say that this most definitely is not the case for all space actors.

We cannot scale up future space activities and continue to take advantage of space technologies without properly coordinating space sustainability and space traffic.

Many would ask why Space Sustainability carries an importance. I will explain different aspects of this question and its relevance to our current time.

Today, we see a steady growth in the number of space actors, with many launching a myriad of space objects. What has been a privilege of few and a luxury to many in the previous decades has now become an affordable opportunity to almost everyone in the sector.

Miniaturization of satellites, increasing number of cost-efficient launch options, escalating frequency of launches, better logistic solutions and accessibility of launch sites from different

parts of the world, growing competitiveness and diversification of launch services market all require change through coordinated action and global commitment.

Even though space is infinite, economically attractive orbital slots are limited per se.

Many space actors are launching space objects without caring about the repercussions. The discrepancy problem of an exponentially growing number of deployed space objects without the foreplanning of what measures will be taken once the objects turn non-functional, makes the space environment unsustainable, thus undermining its value for upcoming space missions and currently offered critical space-based services.

The problem of an unsustainable space environment can be perceived from three different angles: environmental, ethical and economic. From an environmental perspective, space debris risks generating more debris and constitutes a hazard for operational satellites and activities in space. Unsustainable space environment questions the accessibility of space for future generations, raising a vital ethical concern. Risk posed to the safety of an operational environment for space activities, resiliency of space infrastructure or assets, probability of rendering a satellite non-functional requiring its replacement, and the continued provision of services have a direct impact on expected economic benefits and return on investment.

Image, reputation, competitive advantages, and acknowledgement of specific behavioral lines for economic interests represent key incentives for voluntary implementation of space sustainability and space debris mitigation guidelines.

We see an increasing number of stakeholders advocating in the realm of space sustainability (SS) and Space Traffic Management (STM); their numbers are growing and the gap in their consolidation efforts is widening.

Legal grounds have significantly evolved over the last years and we are thrilled to see the long-term sustainability guidelines being adopted. Even though the development mainly took place on the non-binding level, it still portrays a much-needed effort.

The LTS guidelines approach the space sustainability issue from four different angles: 1) policy and regulatory, 2) safety of space operations, 3) international cooperation, capacity-building and awareness, 4) scientific and technical research and developments.

Space can help achieve many Sustainable Development Goals; however, space is a worthy goal in itself and deserves to be added as the 18th Goal. In parallel to this, the space community should start thinking about Space Sustainability Goals.

The ESA Annual Space Environmental Report became one of the reference editions in a short period of time. It provides a transparent overview of global space activities, estimates the impact of these activities on the space environment, and quantifies the effect of internationally endorsed mitigation measures.

More specifically, it outlines space environmental history in numbers, environmental status, intentional object release, fragmentation history, end-of-life operations history, and environmental metrics.

Another authoritative initiative that relates to the status of space environment is the Space Security Index (SSI), which is purported to improve trust and transparency related to space activities and to provide a common, comprehensive, objective knowledge base to enhance capacity for dialogue and policies that contribute to the governance of outer space as a shared global common. Previously, the SSI were merely publishing annual reports. However, as of last year, they launched a collection of fact-based guides and assessments of interrelated trends and developments in space.

The World Economic Forum, and more specifically its Global Future Council, came up with the concept of Space Sustainability Rating, which is currently being developed by a consortium of stakeholders. The purpose of this is to support long-term sustainability of the space environment by increasing transparency among actors' debris mitigation efforts. It is expected that SSR will constitute a comprehensive rating for the sustainability of space missions, bringing more transparency to the sector while also rewarding responsible actors.

SS, in addition to responsible behaviors, heavily relies on SSA and STM for responding to the questions 'WHAT' and 'HOW.'

SSA is a tool to know what to coordinate, manage and control. What is critical to know is: Who has the SSA data and where do they get them from? Which data and information are shared? With whom are those SSA data shared? Based on which legal grounds? Under which terms? How to efficiently bridge SSA capabilities with STM mandate?

Knowledge (SSA) without action (STM) has little value, however action (STM) without generally accepted, transparent, certain and thus predictable rules fail to be an efficient solution for a sustainable space environment.

Currently, there are rules for all other types of traffic but not for Space Traffic ... Why is that? This remains an open question.

Proper implementation of STM is based on three pillars: mandate, capabilities, and funding. What activities do we exactly intend to manage? How do we intend to execute this function? Is it about managing, coordinating, regulating, and controlling? Who defines the authority and grants the global mandate for it to be recognized by all space actors? Who has such capabilities? Where is the limit of this mandate? STM might need to coordinate with other related types of traffic, e.g. maritime and air. Who will fund STM?

Space sustainability requires determination, focus and action. This can't be further delayed.

We should more actively promote environmentally conscious and responsible behaviors in space, showcase best practices, assist stakeholders wishing to align their activities with space sustainability guidelines, focus on implementation and enforcement mechanisms, incentivize responsible and environmentally sustainable behaviors, promote the platforms for inclusive and interdisciplinary dialogue on space sustainability and STM, make the dialogue uninterrupted by fostering a continuous engagement and participation of all key actors at all stages of the dialogue, and coordinate the parallel ongoing initiatives on the same subject.

When investing in sustainable space, we invest long-term. Caring about the impact of space activities on the space environment, we must invest in sustainable and eco-friendly solutions and technologies, change or adjust laws and policies, reconsider licensing processes, find the best feasible solutions to incentivizing sustainable space behaviors, and finally, recognize and showcase best practices.

I would like to close my presentation by quoting "Our common future" report through the prism of space: 'space requires sustainable development that meets the needs of the present without compromising the ability of future generations to meet their own needs.'

Dear Colleagues, Ladies and Gentlemen, by incentivizing and showcasing 'environmentally sustainable' and responsible behaviors, we can change the current paradigm.

**Resolution of the International Conference on
"Space Security and Safety Dimensions"
Held at Space Park, Leicester, UK, on September 28-29, 2023.**

Preamble: Recognizing the critical importance of space security and safety in the contemporary era, and the evolving challenges and opportunities presented by space activities, the International Conference on «Space Security and Safety Dimensions» convened experts, researchers, policymakers, and industry professionals from around the globe to deliberate on these crucial issues.

1. Acknowledge the critical importance of space security and safety in the current global context, recognizing the expanding use of space for various purposes, including but not limited to communication, navigation, and earth observation.
2. Recognize the need for enhanced collaboration between professionals, researchers, policymakers, and industry leaders globally to address the emerging challenges in space security and safety dimensions.
3. Emphasize the importance of addressing issues such as space debris, cybersecurity threats, the militarization of space, and the protection of space-based assets to ensure the sustainable use of outer space.
4. Advocate for the sharing of best practices, experiences, and lessons learned in the field of space security and safety, highlighting successful strategies and approaches that can contribute to enhancing global space security and safety measures.
5. Promote research and innovation in space security and safety, encouraging participants to present their work, exchange ideas, and explore new avenues for advancements in this critical area.
6. Stress the importance of raising awareness about the potential risks and threats in outer space and the need for concerted efforts to protect space infrastructure and promote responsible space activities.
7. Urge for the provision of networking opportunities for participants to establish valuable connections and collaborations, enhancing professional development and knowledge exchange.
8. Call for multidisciplinary approaches to space security and safety, welcoming contributions from various disciplines, including engineering, policy studies, law, and international relations.
9. Support international cooperation and collaboration to address space security and safety challenges, fostering dialogue and interaction among participants from different countries.

Closing: This resolution reflects the collective commitment of the conference participants to advancing the objectives of space security and safety. The conference thanks all attendees for their valuable contributions and looks forward to ongoing collaboration in this vital field.

Regional Approaches to Outer Space: Notes from the 29th APRSAF Meeting

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The 29th Asia-Pacific Regional Space Agency Forum (APRSAF) meeting reconfirmed the forum's vital role in regional space initiatives that can further help global coordination in space activities. This report presents such perspective from an intra-region participant's point of view. It highlights key discussions from the 2023 plenary session, emphasizing the Space Policy and Law Working Group's contributions. The importance of the APRSAF's National Space Legislation Initiative (NSLI) in harmonizing space laws and the involvement of young scholars in policy shaping are underscored. The report observes the opportunities and challenges in regional space cooperation in the Asia-Pacific region.

Keywords: APRSAF, Asia-Pacific, regional, space diplomacy.

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Introduction

APRSAF, in cooperation with the Indonesian government, has managed to run its 29th meeting was held in Jakarta from 19-22 February 2023. The meeting has attracted many participants from across the space community in the Asia-Pacific. It demonstrated the forum's vital role in regional space collaboration and how it can be beneficial for greater goods in global level.

This report briefly reviews the APRSAF and its agenda in its 29th meeting. More attention was put particularly on the Space Policy and Law Working Group (SPLWG) as well as its relatively-new National Space Legislation Initiative (NSLI) and Young Scholars Essay Competition. In the end, some key takeaways are discussed as this report's conclusion.

APRSAF and Its 29th Meeting

The Asia-Pacific Regional Space Agency Forum (APRSAF) was established in 1993. It is a Japan-initiated non-legally binding forum for space agencies and other public/private bodies of the region and beyond. The forum's main aim is to enhance space activities in the Asia-Pacific region.

In 2023, its 29th meeting was held in Jakarta from 19-22 September 2023. In addition to the plenary meetings, it organizes five working groups, namely *Satellite Applications, Enhancement of Space Capability, Space Education, Space Frontier, Space Policy and Law* (SPLWG), as well as Space Industry Workshop. The forum's meetings also showed its supports towards the establishment of international projects, both among entities inside the region and around the globe. The meetings of the working groups preceded the plenary sessions.

Of all working groups, the SPLWG had a strong focus on the issues of space law and policies. Its two-day meetings consist of various presentations and discussion sessions. The presentation sessions include the topics of Indonesian space law; Space Sustainability Rating; industry in the Region; Common Assessment for Space-based Policy; Space for SDGs; ASEAN Space Agency; and Philippines on space sustainability. More sessions include the discussion on the topics of a sustainable public-private partnership for the sustainable use of outer space; accelerating the contribution to SDGs in the Asia Pacific; APRSAF's perspectives on International Space Traffic Management.

A key highlight should be on a session discussing the progress of the National Space Legislation Initiative (NSLI). This initiative was established on 26th APRSAF meeting in 2019. Its main objectives are to promote information sharing and mutual learning on national space legislation and policies in APAC region and to enhance capacity to draft and implement national space legislation and policies based on international norms. To achieve that, the main task is to jointly draft a report on the status of national space legislations of NSLI members for submission to UNCOPUOS. This initiative has involved at least thirteen Asia-Pacific countries.

The NSLI has achieved the end of its second phase and the achievement was reported on this meeting. The second phase was chaired by Yumiko Tateshita (JAXA/Japan) and Yunita Permatasari (BRIN/Indonesia). They have managed to submit the "Report on the status of the national space legislation of countries of the Asia-Pacific Regional Space Agency Forum National Space Legislation Initiative, second phase" to the Legal Subcommittee of the UNCOPUOS in 2023. They reemphasized that NSLI's work is based on a UNGA resolution "Recommendations on National Space Legislation" in 2013. In the process, the initiative's study group discussions and report writing based on special questionnaire and "information form" completed by NSLI participating organizations. Following this achievement, the third phase has been launched at APRSAF-29 and its activity will be for 2 years by APRSAF-31 in 2025. Their report was also complemented by a keynote speech from UNOOSA's representative as well as country-reports on the "Authorisation and Supervision" of space launch from Indonesia, Australia, Japan, South Korea, Thailand, Philippines.

Another special session was the Young Scholars Essay Competition presentations for which this report's author participated in it. This competition has been held since last year and this year's topic was on "Private Roles and Cooperation in the Asia-Pacific." In these sessions, essays were presented around the topic: historical role of space-based private entities; how they can do for safety-sustainability; crowdsourcing; and innovative ownership to prevent monopoly using blockchain technologies. Discussions took regionally-relevant cases that was

probably rarely discussed in global context. This review's author's essay won the Grand Prize after presenting a historical lesson from Indonesian private companies' role through space activities.



Figure 1 Some pictures of the Author's participation in the 29th APRSAF Meeting.

Following fruitful working groups sessions, the Meeting held two-days plenary sessions. Each working group presented their reports. Countries also gave their national reports, including Australia, India, Indonesia, Japan, South Korea, Malaysia, Philippines, Singapore, Thailand, United Arab Emirates, and Vietnam. Some discussions also were held on the plenary session: accelerating space economies through regional partner; sharing the practices for ensuring the sustainable use of outer space; how to manage and respond to common regional issues through partnerships with diverse players; nurturing future generation for sustainable development of space activities in the Asia-Pacific region. Prof Anupam Ojha OBE from the UK Space Agency and University of Leicester participated in several sessions. After summary reports being presented at the end, the Meeting announced its 30th session in Perth, Australia, for 2024.

Key Takeaways

It was observed that regional approaches could help coordinate countries in shaping international space law or norms before going into global-level discussions. Particularly, the NSLI has demonstrated the possibility to harmonize national law-making softly through actionable regional cooperations. In addition to such programmatic approach, the Meeting also open possibility to hearing “not-so-loud” voices on space legal or political issues from future generations of the region which are relatively unheard in global level. However, regional challenges still present based on two observations: (a) the presence of Taiwan Space Agency/TAXA alongside the apparent absence of People Republic of China representatives; (b) considering another regional alternative, that is China-led the Asia-Pacific Space Cooperation Organization (APSCO). There is some hope for more participations in and results from the 30th Meeting in Australia.

Promoting Safety and Security: Challenges for the Future Governance of Space Activities

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This paper presents a comprehensive examination of the current and emerging challenges in the governance of space activities, focusing on promoting safety and security. Key international treaties and resolutions, including those under the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), are discussed, highlighting their evolution in response to changing geopolitical dynamics and the expansion of space activities across various sectors. The paper addresses several critical challenges: ensuring diverse global voices are heard in space governance, managing the dichotomy of space in terms of its strategic value and dual-use nature, achieving consensus among the rapidly growing number of space-faring nations, defining and delimiting space, adapting to the commercialization of space activities, and confronting the growing problem of space debris.

Keywords: Space Governance, International Space Law, Space Safety, Space Security, UNCOPUOS, Space Debris, Space Commercialization, Global Consensus, Legal Framework, Space Race.

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Introduction

In an era where space activities have become increasingly pivotal to our global society, the necessity for effective governance in this realm is more pressing than ever. From the launch of the first satellite to the adoption of various United Nations General Assembly (UNGA) Resolutions and treaties under the auspices of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), we have witnessed a significant evolution in space law. This evolution is reflective not only of the changing geopolitical landscape but also of the expansion of space activities into diverse sectors, including military, commercial, scientific, and cultural realms.

There is Already Much Important (and Relevant) International Space Law that regulates Safety and Security:

- Outer space is not a 'lawless' frontier ...
- Customary International Law 1957-1967
- UNGA Resolutions 1960s – major points reflected in a series of Nations Treaties
- UN Treaties – through auspices of UNCOPUOS
 - Outer Space Treaty (1967)
 - Rescue Agreement (1968)
 - Liability Convention (1975)
 - Moon Agreement (1979) – 'rejected' by major industrialized powers – inability to agree on further treaties.

1980s:

- UNGA Principles – Increasingly complemented by 'hard' and 'soft' law guidelines – including TCBMs
- Emergence of **national law** (approximately 30-40 States and counting...)

Challenge #1 – Listening to all 'Voices' (not just the loudest ones)

Space is Multi-Faceted and Ubiquitous

→ This Requires a Holistic Approach to Space Governance

- Political
- Military / National Security
- Commercial
- Legal
- Scientific
- Exploratory
- Civil
- Cultural
- Religious
- Heritage
- Other?

→ inextricably linked to human rights and the future of humanity

Challenge #2 – Addressing the Inaccurate 'Dichotomy' of Space

4 October 1957 – the 'space race' → immediate legal issues

- Geopolitical context – Cold War
- Recognition of strategic 'value' of space
 - need for legal framework
- Need for (UN) Coordinating Organizations – bifurcation of mandates
 - UNCOPUOS – law making / peaceful activities
 - Conference on Disarmament – weapons/ space security / military uses
 - Distinction blurring (particularly due to 'dual-use' nature of space activities).

Who 'Creates' the International Framework?

UNCOPUOS

- Permanent Committee 1959 – UK a Foundational Member State

- Mandate includes:
 - Study legal problems / issues
- Two Subcommittees:
 - Scientific and Technical
 - Legal
- Currently 102 members – and growing fast!
- Consensus approach to decision-making.

Challenge #3 – Achieving Consensus in a Complex and Diverse World

- UNCOPUOS Member States as at 2023:

Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahrain, Bangladesh, Belgium, Belarus, Benin, Bolivia, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chad, Chile, China, Colombia, Costa Rica, Cuba, Cyprus, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Finland, France, Germany, Ghana, Greece, Guatemala, Hungary, India, Indonesia, Iran, Iraq, Israel, Italy, Japan, Jordan, Kazakhstan, Kenya, Kuwait, Lebanon, Libya, Luxembourg, Malaysia, Mauritius, Mexico, Mongolia, Morocco, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Republic of Korea, Romania, Russian Federation, Rwanda, Saudi Arabia, Senegal, Sierra Leone, Singapore, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Sudan, Sweden, Switzerland, Syrian Arab Republic, Thailand, Tunisia, Turkey, the United Arab Emirates, the United Kingdom of Great Britain and Northern Ireland, the United States of America, Ukraine, Uruguay, Uzbekistan, Venezuela, Viet Nam

- What is consensus? / How to achieve consensus?
 - ‘A general agreement’
- Everyone in full agreement?
- Everyone agrees not to disagree?
- Negotiations / bargaining / ‘horse trading’

Challenge #4 – Resolving (or not) the delimitation / definition of Space

- Sputnik 1 – ‘instant’ customary law?
 - Implications for Regulation
 - Territorial / Jurisdictional issues
- Beyond National Jurisdiction
 - Definition? / Delimitation?

Challenge #5 – Adapting to the Commercialisation of Space (and its role)

- Originally considered purely a State activity – but ...
- Legal possibility for non-governmental entities engages in space activities
- 2022 – Global ‘Space Economy’ approximately US\$430+ billion, 76% of which involved commercial space activities

- Projected to grow to US\$1-3 trillion by 2040
- Involvement of Private Sector in conflict → implications
- Fast forward to 2023:
 - States → Civil / Commercial / Military activities
- originally only a small number of (industrialised) States
 - now c. 70-80 active space-faring States
 - State / non-State military actors
 - IGOs
 - Commercial Entities (increasingly providing ‘dual use’ services)
 - Research Institutions / Universities / Not-for Profits
 - Individuals / Entrepreneurs etc

Challenge #6 – Addressing the (existential) Problems of Space Debris

- The numbers:
 - 7,100+ ‘live’ satellites
 - 36,500 debris pieces > 10 cm (10,500 tonnes)
 - 1,000,000 debris pieces 1-10 cm
 - 130,000,000 debris pieces < 1 cm
 - Exponential increase in number of space objects
- Collisions: eg 2009 Iridium 33 and inactive Kosmos 2251
- Near Collisions: eg 2020 IRAS and GGSE-4 / regular need to move ISS
- Break-up in orbit: eg 2021 NOAA-17 / Yunhai 1-02 polar-orbiting satellites
- Deliberate destruction of space objects – the space ‘club’
- Debris falling to Earth: eg 2021 Long March 5B Rocket / 2022 SpaceX debris in Australia
- Orbital velocity → collisions lead to cascading effect of more debris → possible ‘Kessler effect’ → challenge to sustainability / accessibility / navigability of space

Other Strategic Issues and Challenges: All related to Safety and Security

- Long-term sustainability of space / space activities
- Small satellite technology / mega/large constellations
- Space traffic management
- Congestion issues – use of spectrum / ‘crowding’ of orbits
- Militarization / Weaponization of space → PAROS → a ‘Peace Race’
- Human (aero)space flight
- Commercial exploitation of natural space resources
- High Altitude Platforms / Drones etc
 - (not space law but ...)

Regulating Space Now and into the Future: Strategic Challenges

Why? How?

Understanding the ‘questions’ that space technologies pose:

- Enabling and ‘future-proofing’ International and National regulatory frameworks
- Involving all aspects of the ‘space-sector’ – listening to all voices

The need for multilateralism

- ‘buy in’ of all stakeholders
- Delays – inherent and deliberate – but have to get it as ‘right’ as possible
- Language of ‘lowest common denominator’

Effective implementation by States?

- Relationship between international law and national law
- Individual interpretation
- ‘Cherry picking’ of obligations
- Influence of domestic factors – economy, industry, risk profile, culture, strategic alignment etc.
- Fragmentation?

Conclusions

In summarizing we conclude that the future of space governance is an intricate and multifaceted endeavor. The exploration of international space law, under the guidance of UNCOPUOS and various UNGA resolutions, has revealed a dynamic and evolving landscape shaped by geopolitical changes and the diversification of space activities into commercial, military, and cultural sectors.

The challenges identified in the paper – from ensuring diverse global perspectives in space governance to tackling the commercialization of space and the ever-increasing issue of space debris – call for a strategic and holistic approach. The importance of adapting legal frameworks to the fast-paced evolution of space activities cannot be overstated. This adaptation requires a keen understanding of the unique dynamics at play, including the intricacies of international consensus, the blurring of military and civilian space uses, and the complexities of territorial jurisdiction in space.

Moreover, the role of national and international entities in shaping the future of space governance is crucial. The interaction between international treaties and national laws plays a pivotal role in creating a coherent and effective governance structure. As space activities expand, encompassing everything from satellite deployment to human spaceflight and the utilization of space resources, the need for robust, inclusive, and forward-looking governance mechanisms becomes increasingly apparent.

In navigating these challenges, we should underscore the necessity for multilateral cooperation and the involvement of all stakeholders in the space sector. The future of space governance lies not only in the creation of comprehensive legal frameworks but also in fostering a culture of collaboration and mutual understanding among the diverse array of actors involved in space activities.

In conclusion, as we venture further into the cosmos, our approach to space governance must evolve in tandem with our expanding capabilities and aspirations. The preservation of space as a realm of peace, exploration, and opportunity for all humanity hinges on our collective efforts to address these challenges effectively.

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Control from Space in Conditions of Demilitarization and Denuclearization of the Aggressor States

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In the article, the concept of the latest tool of global digital governance and administration is formed as control from space in the conditions of demilitarization and denuclearization of the aggressor states. The concepts of “demilitarization of the aggressor state” and “denuclearization of the aggressor state” were formed as global processes. A scheme of the process of demilitarization and denuclearization of the aggressor state is proposed. The role of space in the conditions of active activity of the aggressor states is revealed. The unique characteristics of control from space in the conditions of demilitarization and denuclearization of the aggressor states have been formed. A scheme for implementing control from space in the conditions of demilitarization and denuclearization of the aggressor states is proposed. The international mechanism for verifying control from space in the conditions of demilitarization and denuclearization of the aggressor states has been tentatively defined.

Keywords: aggression, control, demilitarization, digitization, global administration, global governance, international cooperation, nuclear weapons, space, verification, weapon.

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Introduction

The Russian-Ukrainian war from 2022 has turned into more than just a local conflict, as the international community considered it in 2014. This war causes a crisis in European society and destroys a great democratic country and territories of Europe. Ukrainian society is infinitely grateful to the world for its support, but only a citizen of Ukraine can express the pain that permeates this war. Destroyed houses and destroyed nature, killed people and animals, all these terrible phenomena are daily in the life of Ukrainians. And no matter how difficult it

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sounds and is not implemented, the world must provide a mechanism for the demilitarization and denuclearization of the aggressor states, because nature and man are the highest values of this planet, and all the activities of international communities must be reduced to the real protection of these values.

Concepts of demilitarization and denuclearization of aggressor states

The content of the concepts of demilitarization and denuclearization of the aggressor states and the interrelationship of space control within these concepts should be formed. Demilitarization was how prohibiting the deployment of nonconventional weaponry started. After 1945 global and regional geopolitical competition spread to Antarctica, leading to claims on the sole continent not to have been colonized by humans, incidents between European powers, the United Kingdom in particular, and Argentina and Chile, and military interventions. Although they concluded disengagement agreements, these did not end the geopolitical and legal disputes. By the time of the International Geophysical Year (July 1957–December 1958), it had become increasingly clear that spread of scientific bases across the continent was contributing to international tensions exacerbated by the deepening Cold War. Thus, in June 1958, following a US initiative, the countries then active in Antarctic polar research embarked on negotiating a treaty that would guarantee the right to research and limit activities to peaceful purposes only. It was proposed to demilitarize the Antarctic continent and limit the presence of military to logistics. Argentina proposed a ban on all nuclear explosions, which placed it in opposition to the United States, which was only willing to accept a prohibition of unannounced tests (Zanders, 2022).

The Outer Space Treaty set up the framework for several other international agreements on collaboration in space. One of them, the Moon Agreement adds greater precision in several areas, including the exploitation of natural resources and scientific research on celestial bodies within the solar system. From an arms control perspective, Article 3 is central. It not only demilitarizes the Earth's moon or proscribes hostile acts on the satellite but also prohibits the deployment of nuclear and other nonconventional weapons in any type of trajectory around the moon or on or in its surface. The value of the Moon Agreement is, however, limited as none of the spacefaring countries are parties (France and India have signed but not ratified it). Under the Seabed Treaty, states parties undertake not to deploy NWs or other nonconventional weaponry on or in the seabed and ocean floor or any type of infrastructure to store, test, or launch such weaponry. The agreement allows for verification, including inspections, and foresees procedures to address noncompliance concerns, including recourse to the UNSC if the matter cannot be resolved through consultations. As with the other three agreements, the Seabed Treaty sought to forestall militarization of an uninhabited space because of scientific and technological advances in the field of oceanography and to preserve such space for peaceful purposes only (Zanders, 2022; Treaty, 1967).

The concept of demilitarization denotes the reduction or even total abolishment of armament (Disarmament) and military presence in a specific geographic area. In operational terms it implies the dismantlement of arms, ammunition, and armed forces in order to put them beyond military use. Demilitarization also connotes the process of sustained reductions in the influence of the military in a given State and society. In many respects demilitarization is the opposite of militarization, which usually describes the complex process of mobilization of resources (Kingma & Schrijver, 2015).

In our opinion, the demilitarization of an aggressor state is a global process in a state that has carried out aggressive actions and is recognized by the international community as an aggressor state, aimed at forced disarmament, revision of defense configurations and transformation of resources that previously served for military purposes, within and on terms that guarantee common security for all nations, with the aim of ensuring lasting harmony and the rejection of violence as a means of resolving international conflicts.

Nuclear weapons created a revolution in military strategy, but the character of that revolution has yet to be fully determined. Nuclear weapons threatened to annihilate the very societies that they were intended to defend if actually used in warfare. Therefore, the purpose of nuclear weapons became primarily the threat of use with the object of deterrence or other political goals, instead of the actual employment of those weapons for the attainment of victory in combat. The US and the Soviet Union faced down one another during the Cold War by using tacit and explicit threats of nuclear escalation but also by forbearance in crisis management and coercive diplomacy. The post-Cold War “second nuclear age” presents new challenges in the control of nuclear weapons, especially the prevention of nuclear weapons spread among new state and non-state actors (Cimbala, 2022).

By resolution 71/258, the General Assembly decided to convene in 2017 a United Nations conference to negotiate a legally binding instrument to prohibit nuclear weapons, leading towards their total elimination. The Assembly encouraged all Member States to participate in the Conference, with the participation and contribution of international organizations and civil society representatives. The Conference took place from 27 to 31 March and from 15 June to 7 July in New York. The Treaty on the Prohibition of Nuclear Weapons (TPNW) includes a comprehensive set of prohibitions on participating in any nuclear weapon activities. These include undertakings not to develop, test, produce, acquire, possess, stockpile, use or threaten to use nuclear weapons. The Treaty also prohibits the deployment of nuclear weapons on national territory and the provision of assistance to any State in the conduct of prohibited activities. States parties will be obliged to prevent and suppress any activity prohibited under the TPNW undertaken by persons or on territory under its jurisdiction or control. The Treaty also obliges States parties to provide adequate assistance to individuals affected by the use or testing of nuclear weapons, as well as to take necessary and appropriate measure of environmental remediation in areas under its jurisdiction or control contaminated as a result of activities related to the testing or use of nuclear weapons. The Treaty on the Prohibition of Nuclear Weapons was adopted by the Conference (by a vote of 122 States in favour, with one vote against and one abstention) at the United Nations on 7 July 2017, and opened for signature on 20 September 2017. Following the deposit with the Secretary-General of the 50th instrument of ratification or accession of the Treaty on 24 October 2020, it entered into force on 22 January 2021 in accordance with its article 15 (The Treaty, 2017).

On the other hand, as an example, nuclear weapons free zones are one of the most important and effective, as well as underexplored, ways to advance nuclear non-proliferation and disarmament. They are a staple in the global nuclear order, contributing not only to regional and world peace, but also to regional and global security and stability. In times past, Nuclear weapons free zones evolved out of a regional perception of an existing or imminent nuclear threat that required regional groups to create binding treaties to ban the use, storage, and testing of nuclear weapons in their region. Although countries within the four areas of the world that are not protected by an Nuclear weapons free zones are faced with an existing nuclear threat based on the mere existence of nuclear weapons on their territory, there have

been very limited efforts to turn these regions into Nuclear weapons free zones. While there have been discussions about creating a weapons-of-mass-destruction-free zone in the Middle East and a denuclearized Korean Peninsula in recent years, political tensions and difficulties have stalled both endeavours (Kutchesfahani, 2019).

In our opinion, the denuclearization of an aggressor state is a global process in a state that carried out aggressive actions or used a nuclear threat as a tool of political pressure, and is recognized by the international community as an aggressor state, aimed at disarming or completely abandoning nuclear weapons and nuclear ambitions, in within limits and on terms that guarantee the common security of all nations, with the aim of ensuring lasting harmony and protecting the planet from nuclear war.

Both of these processes have a global character, because they involve active diplomatic activity to create a proxy between nations and ensure security, promote peace and stability in international relations.

How can the process of demilitarization and denuclearization of the aggressor states actually be launched?

The Russian-Ukrainian war show that the world must see and ensure the further capitulation of the aggressor state – Russia. Further tools for guaranteeing peace should consist not only of bringing the guilty to justice and compensation for damages, it is also necessary to start the processes of demilitarization and denuclearization of Russia as an aggressor state. In the future, potential aggressor states must understand that any aggressive actions will be met with global opposition and absolute disarmament.

The scheme of the process of demilitarization and denuclearization of the aggressor state should have the following form:

1. Recognition of the aggressor state by the international community.
2. Surrender of the aggressor state.
3. Creation of a global commission on demilitarization and denuclearization of the aggressor state.
4. Formation of the limits and conditions of demilitarization and denuclearization of the aggressor state while maintaining a balance between leaving a limited armed status for internal state defense and preventing further aggressive actions.
5. Acceptance of conditions and the beginning of the process of demilitarization and denuclearization of the aggressor state.
6. Completion of the process of demilitarization and denuclearization of the aggressor state.
7. Control over the aggressor state regarding the level of its armament.

Accordingly, at the last stage, it is possible to establish a connection between the processes of demilitarization and denuclearization of the aggressor state and control from space. But before that, it should be established what is the role of space in terms of the active activity of the aggressor states? The active Russian-Ukrainian war showed the real relationship between space and military operations. Specifically, Starlinks, satellites, missile guidance systems and their further navigation are currently associated with space and war on the territory of Ukraine. It is easy to predict that in the future countries that have access to space and will fight among themselves will fight in space, including striking from space or shooting down satellites.

Characteristics of control from space in the conditions of demilitarization and denuclearization of the aggressor states

Antarctica, outer space, and the seabed are international spheres that are not under the sovereignty or control of any state, and as a result of technological developments, the potential exists for an arms race in these locations if there is no international regulation. Arms control has been necessary in these international spheres. Regulation by the international community in these international spheres is easier than in national territories because these regions are open to every nation and international public interest can be pursued (Kurosawa, 2008).

Regarding control from space in the conditions of demilitarization and denuclearization of the aggressor states, it should be noted that this is an undeveloped tool that technically can significantly help in guaranteeing global security. In my opinion, control from space in the conditions of demilitarization and denuclearization of the aggressor states is guaranteed by the international community, space supervision to ensure peace and stability, which includes the process of observation, verification and providing objective evidence of the absence of military activity and nuclear weapons in aggressor states, as well as identifying possible threats and responding to them in order to prevent conflicts and promote global security and disarmament.

What should be control from space in the conditions of demilitarization and denuclearization of the aggressor states:

- guaranteed (the international community must guarantee the fulfilment of the conditions of demilitarization and denuclearization);
- determined (established conditions);
- term (defined for a specific term);
- large-scale (control over the activities of the aggressor states must be on the territories of the state, sea, air and outer space);
- non-appealable;
- objective (the control results must provide objective and accurate information about the military activities of the aggressor state);
- optimal;
- effective;
- balanced;
- secure (preventing data manipulation and ensuring security with reliable systems for collecting, storing and transmitting information from space);
- non-discriminatory (control should be created to guarantee peace, stability and global security, not to destroy a specific state).

The procedure for implementing control from space in the conditions of demilitarization and denuclearization of the aggressor states

Control from space in the conditions of demilitarization and denuclearization of the aggressor states is theoretically possible and can be implemented in case of active international cooperation and involvement of specialized technologies. Theoretically, control from space in the conditions of demilitarization and denuclearization of the aggressor states can be implemented as follows:

1. Creation of a special observer at the United Nations for space security and control from space for aggressor states.

2. Active international and private-public partnership (for example, with NATO, NASA, SpaceX) of the United Nations special observer on space security and space control over aggressor states regarding the creation of a network of satellite control over aggressor states.
3. Creation of an international mechanism for verification of control from space in the conditions of demilitarization and denuclearization of the aggressor states.
4. Creation of a method of response of the international community in case of violation of the conditions of demilitarization and denuclearization of the aggressor states.

The international community should begin the process of forming international control mechanisms and supervision over the processes of demilitarization and denuclearization of the aggressor states, as well as thoroughly form the possibilities and threats of the potential influence of space on such processes.

A network of satellite control over aggressor states can function thanks to a system of satellites and space vehicles designed for observation and data collection, which will be able to detect the movements of military equipment, monitor compliance with the conditions of demilitarization and denuclearization, and also monitor the deployment of nuclear weapons. The satellites must operate without interruption and provide communication and navigation for the international monitoring observers.

The international mechanism for verifying control from space in the conditions of demilitarization and denuclearization of the aggressor states should be an automated system for verifying the state of demilitarization and denuclearization, which will include:

- 1) control, monitoring and periodic checks on the state of demilitarization and denuclearization of the aggressor states;
- 2) public and regular reporting by the UN special observer on space security and control from space to the aggressor states. The report on control from space for the demilitarization and denuclearization of the aggressor states should be a structured and detailed document that should contain information on various aspects of monitoring and implementation of international treaties and agreements. It is important that the frequency of the report is sufficient for timely response to events and implementation of necessary measures to ensure stability and peace;
- 3) technical support for control from space in the conditions of demilitarization and denuclearization of the aggressor states, which allows to ensure the safety and reliability of the demilitarization and denuclearization process.

Conclusions

“Where there’s a will, there’s a way”

In the event of a violation of the conditions of demilitarization and denuclearization by the aggressor state, the international community should form a special methodology that should include effective and timely joint activities, various sanctions, and in some cases even temporary disconnection from the Internet.

In general, active cooperation and effective diplomacy between various countries and international organizations is necessary for the successful implementation of control from space as a necessary tool for countering global aggression. Control from space in the conditions of demilitarization and denuclearization of the aggressor states should be created to avoid nuclear

manipulations and ensure global security. Control from space will allow, first of all, to quickly take measures to counter aggression, contribute to the prevention of conflicts and simplify the diplomatic process of solving global crises, which in general will really protect the lives of thousands of people, preserve the integrity of nature and guarantee peace in the world.



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Collective Security Crisis: Challenges to Space Law and Space Security

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The article focuses on the presence of real risks to sustainable development, which manifest in the everyday reality of today. Attention is drawn to this issue in the context of the privileged position of certain states over others, enabling them to advance the concept of “war and peace” in their favor. Evidence is presented to confirm the lack of security guarantees even when adhering to international norms and having official agreements. The problems of state monopolies and individual private entities violating the principle of equality are outlined. The consequences of this phenomenon are demonstrated in the context of regulating outer space. Other challenges for ensuring collective security are characterized through the lens of the absence of sovereignty of any country within the confines of outer space. Various conflict resolution options for violations of rules or the order of space activities are identified, emphasizing the need to develop new rules for space flights and stay on space objects, followed by the implementation of different standards of behavior in space. The overall coherence of the material is achieved through the cumulative use of fundamental research methods such as analysis, argumentation, and presentation of evidence.

Keywords: collective security, space security, crisis, risks, space law, national security, global security

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Introduction

At the outset, it should be noted that collective security as it exists in the world today is a myth. Modern hegemonic countries use balance – of-power policies to force other non-hegemonic countries to reconsider their attitude to war and peace and adapt to their rules of the game. Stable development under threat, we have returned to the Times of the Cold War and to a new round of weapons. All countries began to prepare for war.

The fact that political balance is neither a gift from the gods nor a naturally stable state, but is the result of active human intervention and the action of political forces (Spykman, 2007), was pointed out by a well – known American geopolitics’, the father of the concept of “restraint” and the founder of classical realism in the American theory of international

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relations-Nicholas John Spykman. In his work “America’s Strategy in World Politics: The United States and the Balance of Power,” Spykman claimed that balance in the world can only be achieved in combination with a show of strength in international relations (Spykman, 2007).

And this, unfortunately, is a true statement.

Even, the crisis, which Europe, and other countries experiences, was provoked by the war of the Russian Federation against Ukraine. Which showed that the state can sign all kinds of agreements, protocols, fulfil their requirements and norms, but all this still will not guarantee its security.

As a clear example, we can cite the Memorandum on security assurances in connection with Ukraine’s accession to the Treaty on the Non-Proliferation of Nuclear Weapons, which was signed between Ukraine and the guarantor countries – the Russian Federation, the United Kingdom of Great Britain and Northern Ireland and the United States of America.

These guarantor countries have assumed the following obligations: 1) respect the independence and sovereignty and existing borders of Ukraine; 2) refrain from the threat or use of force and/or weapons against the territorial integrity or political independence of Ukraine; 3) do not use nuclear weapons against Ukraine. That is, a direct ban was established against the use of nuclear weapons, and as for other types of weapons and threats of the use of nuclear weapons, there was only a recommendation – to refrain (Memorandum, 1994).

And the most interesting point that was defined in the analyzed agreement was in what way these guarantees will be realised in case of a situation, if Ukraine will be threatened with nuclear weapons use or becomes a victim of an act of aggression. They will ask the United Nations Security Council to provide assistance to Ukraine and consult with each other. But we have all seen how the UN Security Council reacted to the events in Ukraine with its veto power of the hegemonic countries. And what do consultations with Russia lead to?

And for this, Ukraine gave up its nuclear arsenal, and it was at that time the third in the world in terms of number.

Discussion

Thus, security is traditionally understood in connection with the sovereignty of a state and its territorial integrity, as stated in Article 2(4) of the UN Charter (UN, 1945). However, modern realities indicate the existence of security problems without reference to the territories of states and their sovereignty. These problems have gone beyond traditional borders and spread not only to various specific marine zones (Germond, 2015), the Arctic (Geopolitics, 2014), Antarctica (Antarctic, 2012), outer space (Bourbonniere, 2005), but even to cyberspace (The Routledge, 2010). Recent events with monopolist Elon Musk’s (Izvoshchikova, 2023) failure to provide access to the Internet have deprived Ukraine of the opportunity to destroy the Russian fleet in advance, which constantly carried out and continues to carry out rocket attacks on our cities and villages.

So how is it possible to regulate the monopolization of outer space? And how can he talk about collective security in a space environment where not only there are no national borders and territories, but not fully studied the possibilities of using technologies created by people, and most importantly the consequences of their application. For example, the use of an electromagnetic pulse that can burn out electrical networks at a considerable distance and cause extremely heavy damage (Electromagnetic, 2022) or change the trajectory of an asteroid with a kinetic impact (Bardan, 2022).

All this poses new challenges to space law. After all, the basic principles of space activities were adopted 60 years ago. They are extremely important, but they are the least in need of reformatting, and ideally in the development and adoption of new principles and rules of behaviour in space. After all, collective security has always been considered and is being considered in a territorial context and concerned the inviolability of the sovereignty of countries. But space is boundless and there is no place for the sovereignty of any country in it. Therefore, it is necessary to create space security using new approaches, but taking into account mistakes in the past.

First of all, space security has received legal consolidation in the regulatory legal acts adopted within the framework of the UN, in which the word “security” occurs more than 100 times, but the very definition of what is “space security” or “security of space activities” is absent.

As an example, we will present some provisions of space law. Thus, in the Outer Space Treaty, the third principle establishes that “space activities are carried out in the interests of maintaining international peace and security and developing international cooperation and mutual understanding” (Treaty, 1966). One of the guarantees of the implementation of the given principle is a norm that enshrines the right of any state participating in space activities to verify the actions of another state party. Namely art. 15 The Agreement on the Activities of States on the Moon and Other Celestial Bodies establishes that:

“... all spacecraft, equipment, installations, stations and facilities on the Moon are open to other participating states. These participating states shall notify the planned visit at a reasonable time in advance in order to allow for appropriate consultations and to take maximum precautions to ensure safety and avoid interference with normal operations at the facility to be visited. In accordance with this Article, any state party may act independently or with the full or partial assistance of any other state party or through appropriate international procedures within the framework of the United Nations Organisation and in accordance with the Charter” (Agreement, 1979).

Thus, the above – mentioned rules have created the order in which there is a right and an obligation, but there is no responsibility for non-compliance with the rules. What happens if a state party prevents such an inspection by another state party or an international organization, for example, a representative of UN. There are several options for a possible settlement of the dispute – consultations and assistance from a global mediator – the UN Secretary-General.

And how long can such consultations take? And what if the parties do not agree and the UN Secretary-General does not help? Then the parties, at their own discretion, choose other peaceful means, taking into account the circumstances and nature of the dispute. But again, the question arises: what other peaceful means are these?

And what if the emergency landing was made not by an astronaut, who, according to space law, should be safe and immediately returned to the state in whose register their spacecraft is listed, but by a private person – a journalist, a traveller? And if a private ship had to make an emergency landing on the territory of a non-friendly country, or even worse on the territory where the military operations are taking place, who will conduct a rescue operation? And in general, what is the legal status of individuals in space? And this is not a question of individual safety of an astronaut or a tourist – it is a question of collective safety in space.

So how can we agree on the security in space if there are no international security tools on Earth today other than military force.

In the history there are such examples when inveterate enemies agreed on the rules and stuck to them. For example, in the Agreement between the Union of Soviet Socialist Republics and the United States of America on the Prevention of Incidents on the high seas and in the airspace above it of May 25, 1972. In which an understanding was set out regarding measures aimed at improving the safety of navigation of ships of their respective armed forces on the high seas.

Specifically, the agreement provides for ():

- steps to avoid collision;
- not interfering in the “formations” of the other party;
- avoiding maneuvers in areas of heavy sea traffic;
- requiring surveillance ships to maintain a safe distance from the object of investigation so as to avoid “embarrassing or endangering the ships under surveillance”;
- using accepted international signals when ships maneuver near one another;
- not simulating attacks at, launching objects toward, or illuminating the bridges of the other party’s ships;
- informing vessels when submarines are exercising near them; and
- requiring aircraft commanders to use the greatest caution and prudence in approaching aircraft and ships of the other party and not permitting simulated attacks against aircraft or ships, performing aerobatics over ships, or dropping hazardous objects near them.

If the rules of this treaty for the actions of sea vessels are used by analogy with spaceships/satellites in outer space, then approximately the following can be obtained:

- that in all cases where spacecraft/satellites are operating close to each other, operators should apply a strategy of keeping them in orbit that would prevent collisions;
- that spacecraft / satellites of one state that operate near an existing satellite formation (groups of satellites performing a coordinated flight) under the jurisdiction and/or control of the second state/other states must coordinate their own maneuvering operations with the operations of the formation);
- that separation by orbit heights for ultra-large satellite systems should be considered as one of the possible options for preventing collisions of both satellites of the same system and satellites belonging to different systems;
- that satellites carrying out an inspection mission in orbit in the immediate vicinity of the non-operated satellite being inspected should operate at a distance that does not exceed the permissible threshold for the probability of a collision;
- spacecraft/satellites that monitor other space boxes/satellites must maintain a distance that excludes the risk of collisions, as well as avoid performing maneuvers that interfere with or endanger other space boxes/satellites that are under observation, so as not to put them in a difficult position and not endanger spacecraft / satellites under surveillance;
- spaceships/satellites of the parties should not simulate attacks by pointing guns, rocket launchers and other weapons towards a passing spacecraft/satellite of the other side, do not launch any objects in the direction of passing spacecraft of the other side, and do not use powerful lighting installations/pulses along the path of passing spacecraft/satellite of the other side.

Let’s summarize:

- the relevant agreement provides for ways to exercise caution and take self-limiting measures and, in general, comply with standards of polite behavior;
- such regulation aims to ensure that states do not cross critical thresholds.

That is, it is clear from the above that first of all it is necessary to develop new rules for space flights and staying on space objects, and only then on their basis to develop various standards of behavior in space.

Conclusion

I would like to note that all of the above poses new challenges to space law. After all, the basic principles of space activities were adopted 60 years ago. They are extremely important, but they are the least in need of reformatting, and ideally in the development and adoption of new principles and rules of behavior in space. After all, collective security has always been considered and is being considered in a territorial context and concerned the inviolability of the sovereignty of countries. But space is boundless and there is no place for the sovereignty of any country in it. Therefore, it is necessary to create space security using new approaches, but taking into account mistakes in the past.

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Long-Term Sustainability of Outer Space Activities and Space Traffic Management

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This research addresses the critical importance of long-term sustainability and coordinated management of space traffic in the era of rapidly increasing space activities. It focuses on the necessity for globally coordinated action and robust legal frameworks to ensure operational, feasible, and enforceable space sustainability and traffic management strategies. The discussion highlights the environmental, ethical, and economic challenges posed by space debris and the proliferation of space activities. It also examines key initiatives and guidelines for space sustainability and traffic management, including the roles of space situational awareness (SSA) and the integration of SSA capabilities with effective space traffic management (STM). The presentation emphasizes the urgency of promoting environmentally responsible behaviors and sustainable practices in space activities, advocating for a future-focused approach that balances current needs with the preservation of outer space for future generations.

Keywords: Space Sustainability, Space Traffic Management, Space Environment, Space Debris, Space Law, Space Policy.

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Introduction

Long-Term Space Sustainability and Space Traffic Management are two highly complex and critical topics for the state of space environment issues that, for now, remain as mere concepts rather than real tools powered by global commitment and engagement fostering order, transparency, certainty and predictability of operations in space.

Who truly cares about these concepts? Who strives to shape an adequate legal enterprise where these concepts are operational, feasible, self-sufficient mechanisms, and fully enforceable for the purposes of accountability? It is unfortunate to say that this most definitely is not the case for all space actors.

We cannot scale up future space activities and continue to take advantage of space technologies without properly coordinating space sustainability and space traffic.

Many would ask why space sustainability carries an importance. I will explain different aspects of this question and its relevance to our current time.

Ethical and environmental concerns

Today we see a steady growth in the number of space actors, with many launching a myriad of space objects. What has been a privilege of few and a luxury to many in the previous decades has now become an affordable opportunity to almost everyone in the sector.

Miniaturization of satellites, increasing number of cost-efficient launch options, escalating frequency of launches, better logistic solutions and accessibility of launch sites from different parts of the world, growing competitiveness and diversification of launch services market all require change through coordinated action and global commitment.

Even though space is infinite, economically attractive orbital slots are limited per se.

Many space actors are launching space objects without caring about the repercussions. The discrepancy problem of an exponentially growing number of deployed space objects without the foreplanning of what measures will be taken once the objects turn non-functional, makes the space environment unsustainable, thus undermining its value for upcoming space missions and currently offered critical space-based services (Goldberg, 2020).

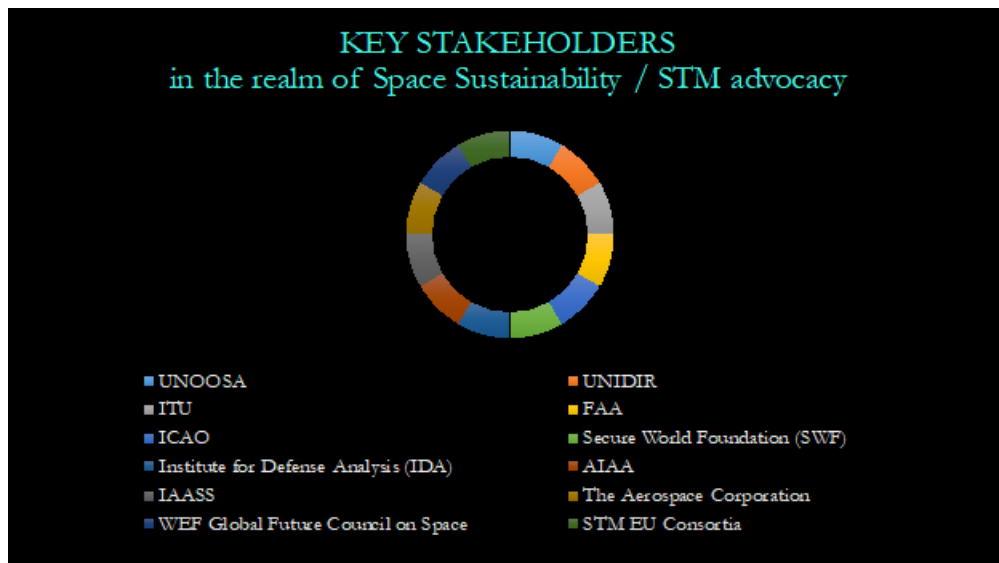
Space environment could be compared to a basket where numerous objects are thrown by different players in an uncoordinated way. Every space actor is governed by its own interests. At a certain point the basket will be full and therefore unable to further accommodate the objects. Same as a limited in size basket, the most economically attractive space resources / orbital slots are also rare and limited. Another comparison could be made to space highways that to be efficiently driven, require clear rules and coordinated efforts / responsible behaviors of all stakeholders.

The problem of an unsustainable space environment can be perceived from three different angles: environmental, ethical and economic. From an environmental perspective, space debris risks generating more debris and constitutes a hazard for operational satellites and activities in space. Unsustainable space environment questions the accessibility of space for future generations, raising a vital ethical concern. Risk posed to the safety of an operational environment for space activities, resiliency of space infrastructure or assets, probability of rendering a satellite non-functional requiring its replacement, and the continued provision of services have a direct impact on expected economic benefits and return on investment.

Image, reputation, competitive advantages, and acknowledgement of specific behavioral lines for economic interests represent key incentives for voluntary implementation of space sustainability and space debris mitigation guidelines.

We see an increasing number of stakeholders advocating in the realm of space sustainability (SS) and Space Traffic Management (STM); their numbers are growing and the gap in their consolidation efforts is widening.

Legal grounds have significantly evolved over the last years and we are thrilled to see the long-term sustainability guidelines being adopted. Even though the development mainly took place on the non-binding level, it still portrays a much-needed effort.



The LTS Guidelines and Space Sustainability Challenge

The LTS guidelines approach the space sustainability issue from four different angles: 1) policy and regulatory, 2) safety of space operations, 3) international cooperation, capacity-building and awareness, 4) scientific and technical research and developments (UNOOSA Guidelines, 2018).

Space can help achieve many Sustainable Development Goals; however, space is a worthy goal in itself and deserves to be added as the 18th Goal. In parallel to this, the space community should start thinking about Space Sustainability Goals.

The ESA Annual Space Environmental Report became one of the reference editions in a short period of time. It provides a transparent overview of global space activities, estimates the impact of these activities on the space environment, and quantifies the effect of internationally endorsed mitigation measures (ESA Report, 2023).

More specifically, it outlines space environmental history in numbers, environmental status, intentional object release, fragmentation history, end-of-life operations history, and environmental metrics.

Another authoritative initiative that relates to the status of space environment is the Space Security Index (SSI), which is purported to improve trust and transparency related to space activities and to provide a common, comprehensive, objective knowledge base to enhance capacity for dialogue and policies that contribute to the governance of outer space as a shared global common (Space Security Index, 2020). Previously, the SSI was merely publishing annual reports. However, as of last year, they launched a collection of fact-based guides and assessments of interrelated trends and developments in space.

The World Economic Forum, and more specifically its Global Future Council, came up with the concept of Space Sustainability Rating, which is currently being developed by a consortium of stakeholders. The purpose of this is to support long-term sustainability of the space environment by increasing transparency among actors' debris mitigation efforts. It

is expected that SSR will constitute a comprehensive rating for the sustainability of space missions, bringing more transparency to the sector while also rewarding responsible actors.

SS, in addition to responsible behaviors, heavily relies on SSA and STM for responding to the questions ‘WHAT’ and ‘HOW.’

SSA is a tool to know what to coordinate, manage and control. What is critical to know is: Who has the SSA data and where do they get them from? Which data and information are shared? With whom are those SSA data shared? Based on which legal grounds? Under which terms? How to efficiently bridge SSA capabilities with STM mandate?

Knowledge (SSA) without action (STM) has little value, however action (STM) without generally accepted, transparent, certain and thus predictable rules fail to be an efficient solution for a sustainable space environment (Nightingale et al., 2016).

Currently, there are rules for all other types of traffic but not for Space Traffic (...) Why is that? This remains an open question.

Conclusions

Proper implementation of STM is based on three pillars: mandate, capabilities, and funding. What activities do we exactly intend to manage? How do we intend to execute this function? Is it about managing, coordinating, regulating, and controlling? Who defines the authority and grants the global mandate for it to be recognized by all space actors? Who has such capabilities? Where is the limit of this mandate? STM might need to coordinate with other related types of traffic, e.g. maritime and air. Who will fund STM?

Space sustainability requires determination, focus and action. This can’t be further delayed.

We should more actively promote environmentally conscious and responsible behaviors in space, showcase best practices, assist stakeholders wishing to align their activities with space sustainability guidelines, focus on implementation and enforcement mechanisms, incentivize responsible and environmentally sustainable behaviors, promote the platforms for inclusive and interdisciplinary dialogue on space sustainability and STM, make the dialogue uninterrupted by fostering a continuous engagement and participation of all key actors at all stages of the dialogue, and coordinate the parallel ongoing initiatives on the same subject.

When investing in sustainable space, we invest long-term. Caring about the impact of space activities on the space environment, we must invest in sustainable and eco-friendly solutions and technologies, change or adjust laws and policies, reconsider licensing processes, find the best feasible solutions to incentivizing sustainable space behaviors, and finally, recognize and showcase best practices.

Quoting “Our common future” report through the prism of space: ‘space requires sustainable development that meets the needs of the present without compromising the ability of future generations to meet their own needs.’ By incentivizing and showcasing ‘environmentally sustainable’ and responsible behaviors, we can change the current paradigm.

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