COMPARATIVE VISIONS IN SPACE LAW

Edited by
Sirio Zolea

Consumatori e Mercato 18

Università degli Studi Roma Tre
Dipartimento di Giurisprudenza

Nella stessa Collana

1. V. Zeno-Zencovich (a cura di), *Cosmetici. Diritto, regolazione, bio-etica*, 2014
2. M. Colangelo, V. Zeno-Zencovich, *Introduction to European Union transport law*, I ed. 2015; II ed. 2016; III ed. 2019
3. G. Resta, V. Zeno-Zencovich (a cura di), *Il diritto all'oblio su Internet dopo la sentenza Google Spain*, 2015
4. V. Zeno-Zencovich, *Sex and the contract* (II ed.), 2015
5. G. Resta, V. Zeno-Zencovich (a cura di), *La protezione transnazionale dei dati personali. Dai "safe harbour principles" al "privacy shield"*, 2016
6. A. Zoppini (a cura di), *Tra regolazione e giurisdizione*, 2017
7. C. Giustolisi (a cura di), *La direttiva consumer rights. Impianto sistematico della direttiva di armonizzazione massima*, 2017
8. R. Torino (a cura di), *Introduction to European Union Internal Market Law*, 2017
9. M.C. Paglietti, M.I. Vangelisti (a cura di), *Innovazione e regole nei pagamenti digitali. Il bilanciamento degli interessi nella PSD2*, 2020
10. L. Scaffardi, V. Zeno-Zencovich (a cura di), *Cibo e diritto. Una prospettiva comparata*, 2020
11. A.M. Mancaleoni, E. Poillot (a cura di), *National Judges and the Case Law of the Court of Justice of the European Union*, 2020
12. E. Poillot, G. Lenzini, G. Resta, V. Zeno-Zencovich, *Data Protection in the Context of Covid-19. A Short (Hi)Story of Tracing Applications*, 2021
13. G. Resta, V. Zeno-Zencovich (a cura di), *Governance by/through Big Data*, 2023
14. E. Poddighe, P. Sammarco, V. Zeno-Zencovich, *European Media & Communication Law*, 2023
15. E. Poddighe, *I tatuaggi fra società, persona e diritto*, 2023
16. A.M. Mancaleoni, R. Torino, *Agri-Food Market Regulation and Contractual Relationships. In the Light of Directive (EU) 2019/633*, 2023
17. I. Rustambekov, S. Gulyamov, A. Ubaydullaeva, *Intellectual Property in the Digital Age*, 2024

Università degli Studi Roma Tre
Dipartimento di Giurisprudenza

COMPARATIVE VISIONS IN SPACE LAW

Edited by
Sirio Zolea

Consumatori e Mercato 18

RomaTrE-Press
2024

Coordinamento redazionale e editoriale:
Gruppo di Lavoro *RomaTrE-Press*

Collana pubblicata nel rispetto del Codice etico adottato dal Dipartimento di Giurisprudenza dell'Università degli Studi Roma Tre, in data 22 aprile 2020.

Elaborazione grafica della copertina: MOSQUITO. mosquitoroma.it

Caratteri tipografici utilizzati:
Brandon Grotesque (copertina e frontespizio)
Adobe Garamond Pro (testo)

Impaginazione e cura editoriale: Colitti-Roma colitti.it

Edizioni: *RomaTrE-Press*
Roma, ottobre 2024
ISBN: 979-12-5977-376-0

http://romatrepress.uniroma3.it

L'attività della *RomaTrE-Press* è svolta nell'ambito della
Fondazione Roma Tre-Education, piazza della Repubblica 10, 00185 Roma

Presentazione della collana "Consumatori e Mercato"

Direttore: Vincenzo Zeno-Zencovich
Comitato Scientifico:
Guido Alpa, Marcello Clarich, Alberto Musso

La Collana "Consumatori e mercato", pubblicata in open access dalla Roma TrE-Press, intende essere una piattaforma editoriale multilingue, avente ad oggetto studi attinenti alla tutela dei consumatori e alla regolazione del mercato. L'intento è di stimolare un proficuo scambio scientifico attraverso una diretta partecipazione di studiosi appartenenti a diverse discipline, tradizioni e generazioni.

Il dialogo multidisciplinare e multiculturale diviene infatti una componente indefettibile nell'àmbito di una materia caratterizzata da un assetto disciplinare ormai maturo tanto nelle prassi applicative del mercato quanto nel diritto vivente. L'attenzione viene in particolare rivolta al contesto del diritto europeo, matrice delle scelte legislative e regolamentari degli ordinamenti interni, e allo svolgimento dell'analisi su piani differenti (per estrazione scientifica e punti di osservazione) che diano conto della complessità ordinamentale attuale.

****

The "Consumer and market" series published, in open access, by Roma TrE-Press, aims at being a multilingual editorial project, which shall focus on consumer protection and market regulation studies. The series' core mission is the promotion of a fruitful scientific exchange amongst scholars from diverse legal systems, traditions and generations. This multidisciplinary and multicultural exchange has in fact become fundamental for a mature legal framework, from both the market practice and the law in action standpoints. A particular focus will be given on European law, where one can find the roots of the legislation and regulation in the domestic legal systems, and on the analysis of different levels, in line with the current complexity of this legal sector.

Table of contents

Contributors 1

Sirio Zolea, *Introduction. Comparative Law in Space: A Training Ground for Cross-Disciplinary Dialogue* 3

Naeem AllahRakha, *Regulation of Commercial Space Activities in the USA and Implementation of the US Experience in Developing Countries* 9

Mario Pasquale Amoroso, *Troubling Technologies in Outer Space: How to Hold States Accountable for Military Activities in Orbit* 35

Valentina Barela, *The Exploitation of Space Resources. A Prospective on Accords and New Governance* 57

Simone Benvenuti, *Fundamental Rights and Outer Space* 73

Andrea Capurso, *The Interplay between International Space Law and Domestic Legislations: New Issues, New Laws, New Solutions* 93

Ignazio Castellucci, *The Dark Side of the (Space) Law* 117

Diana Cerini, *Two Sides of the Same Coin: Insurance for Space Activities and Space Activities for Insurers* 133

Davide Cipelletti, *The Italian Use of Space: A Security Perspective* 149

Marco Di Giugno, *A Regulatory Framework for the Prospective Commercial Aerospace Transportation Operations in Italy* 155

Frans von der Dunk, *Property Rights in Space: Where Does the Law Stand Now?* 169

Antonia Eliason, *Corporations and Outer Space: Strong Legal Foundations* 189

Marco Falcon, *Roman Law Perspectives in Space Law* 203

Maria Gagliardi, *The Law of Space Technology and Information: Risk Management and Liability Models* 213

Diego Mauri, *Hybrid Warfare in Outer Space: Where Does International Law Stand Today?* 223

Stefania Paladini, *The Case for Space Sustainability: Crowded Orbits, Debris Crisis, and Global Space Governance* 243

Marco Pedrazzi, *Liability for Damage Caused by Space Objects: The Interplay between International and National Law* 253

Purvi Pokhariyal, Deepa Dubey, *India's Strategic Roadmap in International Space Law: Critical Analysis* 263

Maria Rhimbassen, *"Breton" Woods: Marketization of the European Space Sector* 287

Mario Ricca, *Space Is More than 'Human Being'. The Anthropological/Cognitive Untimeliness of Contemporary Claims to Rights over Outer Space* 305

Contributors

NAEEM ALLAHRAKHA, *Lecturer,* Tashkent State University of Law, Tashkent

MARIO PASQUALE AMOROSO, *PhD candidate in International Law*, Trento University, Trento

VALENTINA BARELA, *Associate Professor of Private Comparative Law,* Salerno University, Salerno

SIMONE BENVENUTI, *Associate Professor of Comparative Public Law,* Roma Tre University, Rome

ANDREA CAPURSO, *PhD candidate in International Law*, LUISS University, Rome

IGNAZIO CASTELLUCCI, *Professor of Private Comparative Law,* University of Teramo, Teramo

DIANA CERINI, *Professor of Comparative Private Law and Director of CELIS-Centre for Law, Innovation and Sustainability*, University of Milano Bicocca, School of Law, Milan

DAVIDE CIPELLETTI, *Brigadier General*, Italian Air Force, Rome

MARCO DI GIUGNO, *Manager (Director)*, Italian Civil Aviation Authority, Rome

DEEPA DUBEY, *Lecturer*, School of Law Forensic Justice and Policy Studies National Forensic Sciences University, Gandhinagar

FRANS VON DER DUNK, *Professor of Space Law,* University of Nebraska, College of Law, Lincoln

ANTONIA ELIASON, *Associate Professor of Law*, University of Mississippi School of Law

MARCO FALCON, *Senior Researcher in Roman Law,* Padova University, Padua

MARIA GAGLIARDI, *Associate Professor of Private Law*, Dirpolis Institute (Institute of Law, Politics and Development), Scuola Superiore Sant'Anna, Pisa

DIEGO MAURI, *Assistant Professor of International Law,* University of Palermo, Department of Law, Palermo

STEFANIA PALADINI, *Professor of Business Analytics,* Queen Margaret University, Edinburgh

MARCO PEDRAZZI, *Full Professor of International Law,* Milano Statale University, Milan

PURVI POKHARIYAL, *Professor and Dean*, School of Law Forensic Justice and Policy Studies National Forensic Sciences University, Gandhinagar

MARIA RHIMBASSEN, *Associate Researcher,* University of Toulouse I Capitole, Toulouse

MARIO RICCA, *Full Professor in Intercultural Law,* Roma Tre University, Law Department, Rome

SIRIO ZOLEA, *Senior Researcher in Private Comparative Law*, Roma Tre University, Law Department, Rome

Sirio Zolea

Introduction

Comparative Law in Space: A Training Ground for Cross-Disciplinary Dialogue

The conference "Comparative Visions in Space Law" was held at Roma Tre University, Law Department, the days February 9-10, 2024, with the involvement of speakers from legal and non-legal fields, not only comparative law and international law, but also philosophy of law, constitutional law, private law, administrative law, roman law, space economy, space diplomacy, and stakeholders from space industry, diplomacy, military, public bodies, and civil society. Speakers came from many countries, in Europe, America, and Asia, invited or selected through a call for papers. This event was conceived in order to discuss and assess, across different legal disciplines and in an evolutionary perspective, the relations between space law and legal models, discussing issues such as: which legal models have more influenced and are more likely to influence the evolution of space law? How do comparative studies already contribute and could furtherly contribute to the development of (domestic and international) space law? How could the debate on public and private space governance benefit from comparative approaches and other innovative and transdisciplinary approaches?

Selected contributions from the conference have been collected in this book, reflecting the cross-boundary approach (in both the senses of national boundaries and academic boundaries) which characterised the event: dialogue among a multitude of disciplines and legal experiences, shaping new horizons of collaboration which are indispensable to understand the economic, geopolitical, diplomatic stakes of space law, and its technical aspects and difficulties. Problems and complications are due to the presence of different interests and of different legal cultures (and related sets of legal instruments), which require a significant effort of compromise and openness to be reconciled to everyone's satisfaction, in order to obtain the peaceful adherence and cooperation of all the stakeholders with the adopted solutions.

After decades of exceptional development of the digital sector, we are witnessing a renewed interest of public and private entities in outer space, with the simultaneous presence of national defense and geopolitical strategic interests and new business interests aiming to profit. Technological evolution and the consequent growing role of space economy require, at all the domestic and international levels, more detailed and certain legal rules. Space law is characterised by a core of international law, but, in our times, it cannot just be defined as a branch of international law. Overlaps and potential conflicts may arise between the old-fashioned multilateral treaties negotiated under the auspices of the United Nations, more limited international agreements of cooperation (e.g., the Artemis Accords), and the domestic choices about regulation of public and private space activities. The relationship and the coordination among all these layers may give rise to uncertainties and contradictions, in presence of different visions and interpretations on some fundamental provisions of the space treaties, such as the principle of non-appropriation of outer space and the principle of free access to all areas of celestial bodies.

Today, a pivotal problem of space law is the difficulty to update, by mutual agreement, an international framework conceived in the Cold War era, in the presence of a different level of technological development, within the context of another geopolitical balance, and before the relevant presence of private space players. The increasing presence in space of private actors raises, beyond the atmosphere, legal issues (such as liability, property, contracts, insurances, securities, private international law, intellectual property, etc.) traditionally characterising the systems of private law and these new features require efficient modalities of dispute settlement. Also other areas of national law, such as administrative law (e.g., on licensing) and competition law are progressively more involved in space. Many of the mentioned sectors of domestic law are now more and more influenced by international harmonization/uniformization of law, through both instruments of soft law and hard law. Space is becoming another field of legal dialogue and legal hybridization, involving these and many other disciplines.

In this context, new directions of research are open for comparative law[1], whose most recent approaches incentivise dialogue between various legal and non-legal disciplines to approach complex problems from a variety of expertise and viewpoints. In a time when the exploration and exploitation

[1] See S. Zolea, *Comparative Space Law: The Space Frontier from a Private Law Perspective*, Brill, forthcoming, 2025.

of outer space is not only a matter of relations between the states, but, with the involvement of private bodies, it is increasingly confronted to issues related to private law, legal comparison could play a new extensive role in understanding, supporting, and assisting the development of domestic and international space law. For this goal, challenging cooperation among scholars and professionals of different disciplines is necessary, particularly (but not only) through an open dialogue between comparative and international law. Legal comparison might become a meeting point and a catalyst of the encounter of a variety of sectorial approaches, whose holistic combination is much more valuable than their mere addition. In a historical moment of new and resurgent international tensions, the comparative method, encouraging dialogue between legal cultures, can turn out to be helpful, *de iure condito* and *de iure condendo*, to keep a common and shared ground between the nations for a reasonable interpretation and application and for a balanced evolution of the legal framework in space, under the sign of peace and cooperation.

The Space Protocol of the Cape Town Convention, through its offer to the space players of an international secured transaction regime for space assets, is an example of utilisation (also) of comparative analysis to propose solutions for space issues. Hopefully, space studies and practice could furtherly benefit from comparative studies on topics such as property interests, harmonisation of cross-border commercial contracts, force majeure/hardship, standards of care for liability, etc., while comparative studies might in turn get precious hints from the contractual practice of an economic sector structurally characterised by unexpected changes of circumstances and, more in general, might methodologically benefit from exercising in dialogue with other disciplines as required by space studies, refining and improving their techniques and approaches in a pioneering training ground.

Such considerations inspired the conference and now inspire this book. The articles, testifying to many approaches and methods, deriving from legal disciplines and from related non-legal disciplines, focus, in a variety of ways and applying multiple forms of comparison, on the mentioned inter-disciplinary questions involving the intriguing relations between space law and legal models. Such papers concern the present challenges of space law in their multifaceted aspects, including traditional issues of private law referred to space; law and geopolitics in space; competition of legal models in space; the role of public and private entities in space governance and space law.

The article of Naeem AllahRakha discusses the applicability of US regulatory approaches for developing countries lacking frameworks to enable private space sector growth. Mario Pasquale Amoroso defines which of the hostile activities in outer space that take place outside the context of an armed conflict could still be of concern to States as a source of international responsibility. Valentina Barela, analysing in depth the exploitation of the space resources, tightens observations on the primordial governance that has been taken in the last decade, referring about the state of play today before investigating the relevance of accords and the profile of new governance that is taking place in a blurred way. Simone Benvenuti reflects upon the rarely investigated interplay between space law and fundamental rights. Andrea Capurso examines the interplay between domestic and international regulation of space, analysing how legal pluralism has spread in the field of space law, especially with regard to the issues posed by new space activities. Ignazio Castellucci explores the 'dark' side of space law, where geo-legal issues are at the center of the political action, by focusing on the 'hidden' capacity of legal systems and institutions of being a tool of political expansion. Diana Cerini investigates issues of insurance for space activities and space activities for insurers. Davide Cipelletti, from the Italian Air Force, explains the features of the Italian defence space strategy. Marco Di Giugno, from the Italian Civil Aviation Authority, describes the regulatory framework for the prospective commercial aerospace transportation operations in Italy. Frans von der Dunk guides the reader through the uncertainties of the legal framework on property rights in space, especially focusing on immovable property. Antonia Eliason provides a theoretical framework for understanding the increased role of corporations in international lawmaking, discussing how space law fits in that framework and arguing that space law is an area where lawmaking is more conventional than in some other cutting-edge areas of technology.

Marco Falcon deals with roman law perspectives in space, starting from the observation that scholars tend to hold on terms and expressions taken from our common legal history, especially in cases where a clear discipline is lacking. The paper of Maria Gagliardi, moving from a perspective of private law, instead of a 'traditional' space law approach, tries to show and to highlight how to manage some space-related risks as far as private entities are involved. Diego Mauri explores the connections between the concept of hybrid warfare and outer space from an international law perspective, delving into the concept of hybrid warfare and exposing difficulties associated with identifying a working definition thereof due to its essentially political – and thus contested – nature. Stefania Paladini explores key aspects of space sustainability starting from its definition and exploring the challenges posed by the current space activities, space debris first of all, also discussing the various international efforts to manage and mitigate these issues and indicating possible roads ahead. Marco Pedrazzi analyses the complex issues of liability for damage caused by space objects, between international and national law. Purvi Pokhariyal and Deepa Dubey critically assess the existing international space conventions, discussing how India can craft its own space law framework and reap its benefits. Maria Rhimbassen analyses competition law issues in the space context. Mario Ricca addresses the topic of global commons with reference to outer space from an interdisciplinary perspective, in order to promote research on the alteration of anthropological assumptions underlying legal categories that experience in outer space inevitably produces.

Naeem AllahRakha

Regulation of Commercial Space Activities in the USA and Implementation of the US Experience in Developing Countries

Summary: 1. Introduction – 2. Methodology – 3. Results – 4. Discussion – 5. Conclusion.

1. *Introduction*

The ascendancy of commercial space enterprises signals a new era in outer space exploration and utilization for the benefit of humanity[1]. Spurred by technological innovations, declining costs of access to space, and promising market opportunities, the private space industry has witnessed exponential growth over the past decade. Ranging from satellite manufacturing and launch services to space mining and tourism, commercial space activities generate significant economic value while advancing scientific research and development[2].

> *"Men go into space … to see whether it is the kind of place where other men, and their families and their children, can eventually follow them. A disturbingly high proportion of the intelligent young are discontented because they find the life before them intolerably confining. The moon offers a new frontier. It is as simple and splendid as that."* The Economist, 1969

The adequate policy, legal and regulatory frameworks are imperative

[1] Shammas, V. L., & Holen, T. B. (2019). One giant leap for capitalistkind: private enterprise in outer space. *Palgrave Communications, 5*, 10. https://doi.org/10.1057/s41599-019-0218-9

[2] Rausser, G., Choi, E., & Bayen, A. (2023, October 24). Space Exploration: Economics, Technologies, and Policies. Public–private partnerships in fostering outer space innovations. *Proceedings of the National Academy of Sciences of the United States of America, 120*(43), e2222013120. https://doi.org/10.1073/pnas.2222013120

to ensure the safe, sustainable and responsible conduct of expanding private sector space endeavors. While the United States has proactively formulated policies and regulations that catalyze growth of its commercial space industry, developing countries still face myriad challenges[3]. Absence of overarching national space legislations, outdated regulations rooted in erstwhile government-centric models, bureaucratic procedural complexities and lack of institutional coordination constrain advancement of private space enterprises across the Global South[4]. This regulatory void hinders investment, stalls licensing and authorization processes, escalates costs and amplifies liabilities - severely throttling the space industry's progression.

Therefore, developing countries stand to gain immensely from localizing relevant aspects of the US regulatory framework given its demonstrated success in spurring private sector participation. However, customization suited to specific constraints and priorities is necessary. Through comprehensive national space laws modeled on pioneering US legislature such as the Commercial Space Launch Act, streamlined licensing regimes, favorable liability stipulations and dedicated institutional mechanisms - an enabling environment for commercial space activities can emerge in developing countries, allowing sustainable expansion of their indigenous space industry. This paper examines evolution of US national space policies, laws, regulations and institutional frameworks that foster private sector growth. By analyzing limitations in regulatory architectures across developing countries, targeted recommendations are presented on adapting US regulatory best practices to local contexts.

Thereafter, specific regulatory gaps, capacity challenges and bottlenecks hindering advancement of private space industry in developing countries are highlighted through secondary data analysis. A phenomenological approach assesses applicability and localization potential of suitable US regulatory approaches, policies and best practices for developing countries in framing their own national space law and governance mechanisms aimed at sustaining the burgeoning commercial space sector. With the accelerating wave of innovation in space technologies, timely rectification of prevailing deficiencies in regulatory regimes across developing countries

[3] Palmroth, M., Tapio, J., Soucek, A., Perrels, A., Jah, M., Lönnqvist, M., Nikulainen, M., Piaulokaite, V., Seppälä, T., & Virtanen, J. (2021). Toward Sustainable Use of Space: Economic, Technological, and Legal Perspectives. *Space Policy, 57*, 101428. https://doi.org/10.1016/j.spacepol.2021.101428

[4] Marquardt, J., Fünfgeld, A., & Elsässer, J. P. (2023). Institutionalizing climate change mitigation in the Global South: Current trends and future research. *Earth System Governance, 15*, 100163. https://doi.org/10.1016/j.esg.2022.100163

is imperative to reap the fruits of the expanding global space economy. This paper argues for the urgent need to formulate enabling regulatory frameworks customized to local realities that build on demonstrated successes seen in pioneering examples like the United States.

2. *Methodology*

This study utilizes qualitative research methods including doctrinal legal analysis and phenomenological policy assessments to examine regulatory frameworks governing commercial space activities. Comparative analyses of existing laws, regulations and institutional mechanisms in the United States versus developing countries are undertaken to highlight advancements, gaps and policy implications. Doctrinal legal analysis involves a systematic exposition of legal principles, statutes and precedents contextualized within jurisprudential underpinnings[5]. Legislative intents, regulatory frameworks and judicial interpretations are scrutinized to elucidate the political economy shaping commercial space governance models in the US and across developing countries. Regulatory limitations and barriers constraining private sector participation are identified through doctrinal examinations of current legal-institutional architectures.

Thereafter, a phenomenological approach with elements of grounded theory is adopted to assess localization potential of US regulatory best practices for developing countries seeking to formulate enabling policy regimes and national space laws. Phenomenology focuses on the first-person perspective to extract meanings and essences of lived experiences, allowing inductive theory development through iterative examinations[6]. This facilitates contextual adaptation of US regulatory approaches to address ground realities and specific constraints in developing countries. Primary data comprises national legislations, statutes, policies and judicial verdicts related to commercial space activities in the US and chosen developing countries. Secondary data encompasses government reports,

[5] Bhat, P. I. (2020). Doctrinal legal research as a means of synthesizing facts, thoughts, and legal principles. In *Idea and Methods of Legal Research*. Delhi. Oxford Academic. https://doi.org/10.1093/oso/9780199493098.003.0005

[6] Bouzioti, D. (2023). Introducing the Phenomenological Model of Performance Practice (PMPP): Phenomenological Research Design and the Lived Experience in Performance. *International Journal of Qualitative Methods*, 22(1), Article 11142. https://doi.org/10.1177/16094069231211142

industry analyses, working papers and media articles highlighting regulatory frameworks, emerging gaps and debates.

Data analysis involves qualitative coding to identify core themes and categories linked to research questions which are iteratively examined to propound policy recommendations. Rationale for chosen methods lies in their efficacy in conducting in-depth legal and policy analyses across multiple jurisdictional contexts. Doctrinal examinations reveal historical-political contours shaping regulatory approaches while phenomenology enables grounded assessments tailored to local particularities in developing countries. Together, a comprehensive understanding of precedents, limitations and localization opportunities emerges - lending credence to overall research findings.

3. *Results*

The analysis demonstrates that pioneering US national space policies, legislature such as the Commercial Space Launch Act, streamlined licensing frameworks and emerging space traffic management systems have effectively cultivated an enabling environment for private sector growth. Regulatory efficiency is evidenced in rising numbers of commercial space operators and launches from the US over past decades. In contrast, developing countries display substantive deficiencies in regulatory architecture that constrain advancement of indigenous space industries. Absence of overarching national space laws, outdated liability protocols rooted in government-era models and bureaucratic procedural complexities pose significant barriers for commercial actors[7].

Secondary assessments of prevailing legal-institutional mechanisms governing private space activities in select developing countries highlight major regulatory gaps. Most countries lack dedicated national space legislations with specific statutes facilitating private industry participation in domains like satellite manufacturing, ground stations operations and sub-orbital spaceflights. Outdated liability clauses escalate risks and costs for pioneering commercial space companies, severely inhibiting market

[7] Knarzer, S. (2020). The (Regulatory) Force is with You: Using Early Aviation to Anticipate the Black Holes in the FAA's Proposed Regulatory Changes for Commercial Human Space Flight. *Administrative Law Review Accord, 5*(4). Retrieved from https://www.administrativelawreview.org/wp-content/uploads/2020/05/ALR-Accord-5.4_Knarzer-Comment.pdf

entry and investments. The bureaucratic red tape abounds through multi-agency approvals spanning months for licenses and permits, contrasting the streamlined 'one-stop-shop' frameworks administered by the FAA in the US[8].

Dearth of technical capacity among regulator workforces poses knowledge barriers regarding rapid innovations within the commercial space sector. Cumbersome regulatory procedures and absence of supportive incentives amplify opportunity costs for commercial space firms in developing countries. Phenomenological examinations reveals optimism among private space enterprises in developing countries towards progressive regulatory reforms modeled on US legislation and institutions. However, concerns persist regarding influence of entrenched governmental interests that may resist liberalization to preserve status quo interests. Risks of poorly localized regulations and inadequate safeguards are also highlighted, emphasizing the need for balanced frameworks aligned to local priorities[9].

4. *Discussion*

The space industry, encompassing all public and private entities involved in space-related products and services, has witnessed significant growth, reaching a revenue of $427.6 billion in 2022, up from the previous year[10]. A major contributor to this revenue surge is the commercial spaceflight sector, primarily driven by satellite launches into Earth's orbit. Commercial launch providers placing various satellites, including those for communications, mapping, weather monitoring, and space stations, into both low Earth orbit (LEO) and geosynchronous Earth

[8] Garipov, G., Grigoriev, A., Khrenov, B., Klimov, P., & Panasyuk, M. (2018). High-Energy Transient Luminous Atmospheric Phenomena: The Potential Danger for Suborbital Flights. In *Extreme Events in Geospace: Origins, Predictability, and Consequences* (pp. 473-490). https://doi.org/10.1016/B978-0-12-812700-1.00019-4

[9] Horváth, D., & Szabó, R. Z. (2019). Driving forces and barriers of Industry 4.0: Do multinational and small and medium-sized companies have equal opportunities? *Technological Forecasting and Social Change, 146*, 119-132. https://doi.org/10.1016/j.techfore.2019.05.021

[10] Han, Y., Chen, Z., Hu, Y., et al. (2023). A PIE analysis of China's commercial space development. *Humanities & Social Sciences Communications, 10*, 744. https://doi.org/10.1057/s41599-023-02274-w

orbit (GEO)[11]. Notably, a substantial portion of the industry's income stems from infrastructure and support for space activities, such as ground stations facilitating satellite communication. The commercial space sector's dynamism is characterized by private capital at risk, non-governmental customers, market-driven viability, and a shared responsibility among stakeholders[12].

The evolution of commercial spaceflight represents a significant stride in the exploration and utilization of outer space. Beyond its historical roots in the 1960s, the industry burgeoned in the 21st century, with private enterprises taking the reins in developing and operating spacecraft. This paradigm shift has not only fostered scientific research for the benefit of humanity but has also spawned lucrative business opportunities[13]. Space tourism, a facet of commercial spaceflight, involves recreational journeys into space, encompassing sub-orbital, orbital, and even beyond Earth's orbit flights. Despite the substantial costs, the sector is anticipated to burgeon, with projections estimating a $3 billion industry value by 2030. Pioneers like Dennis Tito, Mark Shuttleworth, and Gregory Olsen, who embarked on fee-paying space trips, symbolize the increasing accessibility of space for civilians[14]. The commercial spaceflights become more routine, their impact reverberates across the economy, stimulating job creation and fostering innovation in space manufacturing, medical research, technology development, and beyond[15].

NASA, a key player in space exploration, currently oversees the International Space Station, the Orion spacecraft, and the Space Launch System for the Artemis lunar program. Responsible for air and space-related science and technology, it collaborates with private space technology

[11] Peterson, K. M. (2003). Satellite Communications. In *Encyclopedia of Physical Science and Technology* (3rd ed., pp. 413-438). https://doi.org/10.1016/B0-12-227410-5/00673-6

[12] Davidian, K. (2021). What makes space activities commercial? *Acta Astronautica, 182*, 547-558. https://doi.org/10.1016/j.actaastro.2021.02.031

[13] Weinzierl, M., & Sarang, M. (2021, February 12). The Commercial Space Age Is Here. *Harvard Business Review*. https://hbr.org/2021/02/the-commercial-space-age-is-here

[14] Codignola, L., Schrogl, K.-U., Lukaszczyk, A., & Peter, N. (Eds.). (2009). *Humans in Outer Space - Interdisciplinary Odysseys*. Springer Vienna. https://doi.org/10.1007/978-3-211-87465-3

[15] Weinzierl, M. (2018). Space, the Final Economic Frontier. *Journal of Economic Perspectives, 32*(2), 173–192. https://doi.org/10.1257/jep.32.2.173

companies, fostering a dynamic space industry[16]. In 2022, the global space economy exhibited robust growth, reaching $546 billion, and is anticipated to surge by 41% in the next five years. With over 10,000 private space tech companies, 5,000 major investors, and 130 state organizations contributing to a diverse landscape, the sector's expansion is noteworthy[17]. The commercialization of space, facilitated by its approach, enables private entities, led by influential figures like Elon Musk and Jeff Bezos, to own and operate space systems[18]. Their endeavors have propelled space exploration into the forefront of the private sector, marking a significant shift in the dynamics of the global space industry.

The Commercial Space Launch Act establishes a regulatory framework for space launch activities within the United States, ensuring that individuals or entities seeking to launch vehicles or operate launch sites comply with licensing requirements. Under the purview of the Secretary of Transportation, licenses may be issued or transferred, subject to specified conditions and procedures. The Secretary holds the authority to suspend, revoke, or modify licenses in cases of substantial non-compliance. The Act grants the Secretary the power to immediately terminate, prohibit, or suspend licensed operations deemed detrimental to public health and safety, property safety, or national security interests. Monitoring activities of licensees by federal officials, the use of government property, and the obligation to maintain liability insurance are mandated. The Act enforces civil penalties for violations and necessitates annual reporting to congressional committees, with a specific focus on potential adverse effects of federal statutes, treaties, regulations, and policies on commercial launches[19].

The Federal Aviation Administration (FAA), specifically the Office of Commercial Space Transportation, safeguarding public safety and promoting U.S. commercial space transportation. The agency mandates

---

[16] Witze, A. (2022, November 22). NASA's Orion spacecraft reaches the Moon - in pictures. *Nature*. Advance online publication. https://doi.org/10.1038/d41586-022-03819-w

[17] Grush, L., Kendall, T., & Bloomberg. (2023, July 25). The commercial space industry, led by Elon Musk's SpaceX, is expected to blast off with 41% growth over the next 5 years. *Fortune*. https://fortune.com/2023/07/24/space-industry-revenue-growth-five-years/

[18] Parrella, R. M., Spirito, G., Cirina, C., & Falvella, M. C. (2022). The New Space Economy and New Business Models. *New Space, 10*(4). https://doi.org/10.1089/space.2021.0020

[19] Mineiro, M. (2010). Regulation and licensing of US commercial spaceports. In *Space Safety Regulations and Standards* (pp. 161-176). https://doi.org/10.1016/B978-1-85617-752-8.10014-5

licenses for launches, reentries, and spaceport operations by U.S. citizens globally, focusing on evaluations encompassing policy, safety, airspace integration, and environmental impacts. Experimental permits are granted for research purposes but not for commercial use. Safety oversight involves inspections, compliance enforcement, and investigation of mishaps. The Office of Spaceports aids in infrastructure development, licensing, and global promotion of U.S. spaceports. Notably, commercial human spaceflight occupants operate under limited regulatory oversight, with the FAA issuing licenses and ensuring vehicle safety while leaving health and safety oversight to Congress. Informed consent is emphasized, with participants acknowledging mission hazards, vehicle safety records, and overall safety aspects before engaging in spaceflight operations[20].

In compliance with 14 CFR § 450.43, the FAA conducts a meticulous Payload Review integral to launch or reentry authorizations, while also allowing applicants to independently seek this review in advance. The FAA's scrutiny encompasses confirming that the licensee has acquired all necessary licenses, authorizations, and permits, excluding those within the purview of the FCC, Department of Commerce, or U.S. Government-owned payloads. Commercial Space Transportation evaluates whether the proposed launch or reentry poses risks to public health and safety, property, U.S. national security, foreign policy interests, or international obligations. Detailed information must be provided by the applicant, including payload specifics like name, function, dimensions, weight, ownership details, hazardous materials data, and encryption measures. This thorough evaluation involves collaboration with entities such as the Department of Defense, Department of State, and NASA to ensure a comprehensive assessment aligning with regulatory standards and national interests[21].

The National Oceanic and Atmospheric Administration (NOAA) has eased national security-related licensing restrictions on US commercial remote sensing firms, particularly benefiting startups pioneering advanced

[20] Koller, J. S., Patel, S., Bukley, A., Barr, S. E., Graham, L. D., Seibold, R. W., Melograna, C. A., & Masson, P. A. (2022). *Commercial Human Spaceflight Safety Regulatory Framework* (Aerospace Report No. ATR-2022-02101). The Aerospace Corporation. https://aerospace.org/sites/default/files/2023-03/ATR-2022-02101.pdf

[21] Electronic Code of Federal Regulations. Title 14—Aeronautics and Space, Chapter III—Commercial Space Transportation, Federal Aviation Administration, Department of Transportation, Subchapter C—Licensing, Part 450—Launch and Reentry License Requirements, Subpart B—Requirements to Obtain a Vehicle Operator License § 450.43 Payload review and determination. Legal Information Institute, Cornell Law School. https://www.law.cornell.edu/cfr/text/14/450.43

capabilities. The rule change, announced by NOAA's Commercial Remote Sensing Regulatory Affairs office, opens up the customer base for space-based imaging firms, especially those utilizing synthetic aperture radar (SAR) and space-based sensors[22]. The 2020 restrictions, imposed by the Commerce Department, initially limited the capabilities of commercial satellites, hindering their full potential. The recent modification removes conditions for Tier 3 licensees, including restrictions on SAR resolution, global imaging, and imaging of artificial resident space objects. This move is expected to reduce internal complexity, broaden product offerings, encourage innovation, and facilitate investment in the evolving landscape of the global space economy[23].

The United States emphasizes the foundational importance of safety, stability, and operational sustainability in space activities, urging global recognition and cooperation towards a secure space environment. Timely and accessible Space Situational Awareness (SSA) data and Space Traffic Management (STM) services are deemed crucial, with a commitment to providing basic U.S. Government-derived SSA data and STM services free of direct user fees[24]. Recognizing the escalating threat of orbital debris, the U.S. advocates for revising and enforcing debris mitigation guidelines internationally. The memorandum outlines goals, including advancing Science and Technology for SSA and STM, mitigating orbital debris effects, fostering U.S. commercial leadership, providing government-supported SSA data and STM services to the public, improving data interoperability, developing standards, preventing unintentional RF interference, enhancing the domestic space object registry, and formulating policies for future U.S. orbital operations[25].

---

22 Foust, J. (2023, August 8). NOAA lifts many commercial remote sensing license conditions. *SpaceNews*. https://spacenews.com/noaa-lifts-many-commercial-remote-sensing-license-conditions/

23 Wu, W., Shao, Z., Huang, X., Teng, J., Guo, S., & Li, D. (2022). Quantifying the sensitivity of SAR and optical images three-level fusions in land cover classification to registration errors. *International Journal of Applied Earth Observation and Geoinformation, 112*, 102868. https://doi.org/10.1016/j.jag.2022.102868

24 RAND Corporation. (2023). *International Space Traffic Management: Charting a Course for Long-Term Sustainability*. Santa Monica, CA: RAND Corporation. https://www.rand.org/content/dam/rand/pubs/research_reports/RRA1900/RRA1949-1/RAND_RRA1949-1.pdf

25 Pelton, J. N. (2020). Security Concerns Related to Smallsats, Space Situational Awareness (SSA), and Space Traffic Management (STM). In J. N. Pelton & S. Madry (Eds.), *Handbook of Small Satellites* (pp. xxx-xxx). Springer. https://doi.org/10.1007/978-3-030-36308-6_47

Commercial space technologies fall under the purview of U.S. export control laws, a framework designed to restrict the dissemination of sensitive technologies to foreign entities. Governed by the Departments of State and Commerce, these regulations are integral to safeguarding national security, promoting regional stability, and upholding human rights. Companies engaged in the development and trade of space technologies are obligated to adhere to the Export Administration Regulations (EAR) administered by the Department of Commerce's Bureau of Industry and Security (BIS) and the International Traffic in Arms Regulations (ITAR) overseen by the Department of State's Directorate of Defense Trade Controls (DDTC)[26]. The stringent nature of these controls extends beyond the borders of the United States, imposing compliance obligations on non-U.S. persons involved in the export, reexport, or transfer of space-related items. Such measures underscore the U.S. government's commitment to preventing the proliferation of advanced technologies with potential military applications[27].

The U.S. government's proposed orbital debris mitigation guidelines emphasize responsible practices for commercial operators, specifically targeting launches or reentries with planned altitudes exceeding 150 kilometers. To maintain a sustainable space environment, operators under various regulatory parts must submit an Orbital Debris Assessment Plan (ODAP) before each operation, inclusive of evidence, test results, and removal activity analyses[28]. The proposed rule mandates the removal of debris, including spent upper stages, released during operations, with pieces exceeding 5 mm in size, to be eliminated from highly-used regions within 25 years. Operators have disposal options, such as controlled disposal, maneuvering to a disposal orbit, Earth-escape orbit, retrieval within 5 years, or atmospheric uncontrolled disposal within 25 years, meeting risk criteria. Notably, the FAA aims to curb orbital debris growth by requiring the removal of upper stages and components within 25 years through atmospheric disposal or acceptable orbit maneuvers, addressing concerns of

[26] Rathbone, M., & Pereira, R. (2023, September 29). Export Controls in the United States. *Global Investigations Review*, *Fourth Edition*. https://globalinvestigationsreview.com/guide/the-guide-sanctions/fourth-edition/article/export-controls-in-the-united-states

[27] Riedel, S. (2004). Biological warfare and bioterrorism: A historical review. *Proceedings (Baylor University Medical Center)*, 17(4), 400–406. https://doi.org/10.1080/08998280.2004.11928002

[28] Moser, R. C. (1969). *Space-Age Acronyms: Abbreviations and Designations*. Springer New York, NY. https://doi.org/10.1007/978-1-4615-9594-6

potential hazards and collisions with functional spacecraft in Earth's orbit[29].

The U.S. Space-Based Positioning, Navigation, and Timing Policy (2021), outlined in SPD-7, emphasizes the paramount importance of maintaining United States leadership in global navigation satellite systems, including GPS and foreign systems[30]. The policy underscores the commitment to providing continuous worldwide access to U.S. space-based GPS services without direct user fees, fostering open access to information necessary for equipment development[31]. It prioritizes the responsible use of these systems and aims to enhance their cybersecurity, protect spectrum environments, and improve performance. The policy focuses on denying hostile use of PNT services while ensuring minimal disruption to civil and commercial access. Through international engagement, the U.S. seeks compatibility, interoperability, and transparency with other GNSS providers, encouraging responsible global use[32].

The United States has implemented several institutional mechanisms that significantly foster the growth of the commercial space sector. Notably, NASA's Commercial Crew Program exemplifies a successful partnership with American private industry to achieve safe, reliable, and cost-effective human transportation to and from the International Space Station[33]. Established through the National Aeronautics and Space Act of 1958 (CALCA), NASA collaborates with the National Aeronautics and Space Council, comprising political leaders and private citizens, to coordinate its mission effectively. The United States Space Force, alongside the U.S. Air Force, organizing, training, and equipping personnel to protect U.S. and

---

[29] Pelton, J. N. (2020). US Government and NASA Documents Related to Orbital Space Debris Mitigation. In J. Pelton (Ed.), *Handbook of Small Satellites* (pp. 108-1). Springer. https://doi.org/10.1007/978-3-030-20707-6_108-1

[30] Grunert, J. (2022). Military Involvement from President Eisenhower to President Biden. In *The United States Space Force and the Future of American Space Policy* (pp. 47–127). https://doi.org/10.1163/9789004524064_004

[31] McKenna, A. T., Gaudion, A. C., & Evans, J. L. (2019). The Role of Satellites and Smart Devices: Data Surprises and Security, Privacy, and Regulatory Challenges. *Pennsylvania State Law Review, 123*(3), 3.

[32] Mason, R., Bonomo, J., Conley, T., Consaul, R., Frelinger, D. R., Galvan, D. A., ... Worman, S. M. (2021). Analyzing a More Resilient National Positioning, Navigation, and Timing Capability. RAND's Homeland Security Research Division (HSRD). https://www.rand.org/content/dam/rand/pubs/research_reports/RR2900/RR2970/RAND_RR2970.pdf

[33] Lindenmoyer, A., & Stone, D. (2010). Status of NASA's commercial cargo and crew transportation initiative. *Acta Astronautica, 66*(5–6), 788-791. https://doi.org/10.1016/j.actaastro.2009.08.031

allied interests in space, thereby providing crucial support to the burgeoning commercial space sector[34]. Moreover, the Small Business Innovation Research (SBIR) program, with its goals of stimulating technological innovation and engaging socially and economically disadvantaged small businesses, serves as another institutional mechanism propelling the growth of the commercial space industry[35].

The Outer Space Treaty, established in 1967, serves as the foundational framework for international law governing space exploration. With 105 ratifications and 25 signatures, the treaty upholds principles ensuring that space activities benefit all nations without any claim of sovereignty over celestial bodies[36]. Complemented by subsequent agreements like the Rescue and Return Agreement, Liability Convention, and Registration Convention, it addresses issues such as rescue operations, liability for space objects, and the registration of such objects. Notably, the Moon Agreement, endorsed by only 18 states, expands on the Outer Space Treaty by emphasizing the exploration of outer space as the province of humanity, promoting equality and restricting military activities on celestial bodies. Basic Principles of International Space Law further guide the responsible and cooperative use of outer space, emphasizing mutual assistance, international consultations, and the avoidance of harmful contamination. The international community is bound by these principles, fostering cooperation in the peaceful exploration and use of outer space[37].

Regulating private space activities presents a formidable challenge rooted in a complex web of issues. The proliferation of space debris, resource conflicts, and the growing commercialization and militarization of space demand comprehensive regulatory frameworks[38]. Clarifying matters such as property rights, liability, and the regulation of space resources is

[34] Venable, J. (2021, April 27). Rebuilding America's Military: The United States Space Force. Heritage Foundation. https://www.heritage.org/defense/report/rebuilding-americas-military-the-united-states-space-force

[35] Cooper, R. S. (2003). Purpose and performance of the Small Business Innovation Research (SBIR) Program. *Small Business Economics, 20*(2), 137–151. Link to the article on JSTOR: http://www.jstor.org/stable/40229255

[36] Martin del Campo, J. A. (2021). Finders Keepers: Who Has Say Over Private Property in Space. *Texas A&M Journal of Property Law, 7*(2), 199. https://doi.org/10.37419/JPL.V7.I2.3

[37] Cheng, B. (1997). *The United Nations and the Development of International Law Relating to Outer Space*. Studies in International Space Law. Oxford. https://doi.org/10.1093/acprof:oso/9780198257301.003.0008

[38] Tam, W. (2015). The space debris environment and satellite manufacturing. Walden University. https://scholarworks.waldenu.edu/dissertations

essential. Challenges also arise from the evolving landscape of international space law, particularly concerning the Moon and celestial bodies' natural resources. Major legal issues stem from the prohibition of sovereignty in outer space, complicated by existing treaty laws and geopolitical rivalries extending beyond Earth. The primary hurdle lies in "space jurisdiction" and governance, encompassing a global framework of multinationals, national, or regional rules. Striking the right balance in global space governance, incorporating tools, organizations, and international laws, requires adept management at various government levels[39].

Outdated regulations and bureaucratic processes pose formidable obstacles to the progress of the private space industry. The emergence of innovative technologies has outpaced the adaptability of existing regulatory frameworks, leaving a significant gap in addressing the dynamic nature of space activities led by private enterprises[40]. Traditional rules, initially designed for government-led initiatives, struggle to accommodate the diverse and rapidly changing landscape of private space ventures, creating uncertainty and deterring crucial investments[41]. Cumbersome bureaucratic procedures further exacerbate these challenges, introducing unnecessary delays and red tape. Obtaining permits, licenses, and approvals becomes a protracted and laborious process, hindering the swift development and deployment of space technologies. The elongated bureaucratic cycles not only impede timely industry advancements but also escalate costs, making it arduous for private companies to compete effectively[42].

The dearth of comprehensive national space laws has significantly disrupted the regulatory landscape for commercial space activities. The FAA has sought to fill this void by imposing requirements on crew qualifications, medical screening, and safety elements[43]. However, the absence

39 Johnson, C. D. (2018). The Outer Space Treaty. In *Oxford Research Encyclopedia of Communication*. https://doi.org/10.1093/acrefore/9780190647926.013.43

40 Aspray, W., & Doty, P. (2023). Does technology really outpace policy, and does it matter? A primer for technical experts and others. *Journal of the Association for Information Science and Technology, 74*(8), 885-904. https://doi.org/10.1002/asi.24762

41 Lazarova, M., Caligiuri, P., Collings, D. G., & De Cieri, H. (2023). Global work in a rapidly changing world: Implications for MNEs and individuals. *Journal of World Business, 58*(1), 101365. https://doi.org/10.1016/j.jwb.2022.101365

42 Morrison-Smith, S., & Ruiz, J. (2020). Challenges and barriers in virtual teams: A literature review. *SN Applied Sciences, 2*, 1096. https://doi.org/10.1007/s42452-020-2801-5

43 Contant, C. M., & Logsdon, J. M. (2004). The commercial development of space: Is an international regulatory framework needed? *Acta Astronautica, 54*(8), 585-591. https://doi.org/10.1016/s0094-5765(03)00232-7

of standardized regulations for licensing, liability, and safety measures has left companies grappling with uncertainties, impeding the seamless growth of the space industry. The fragmented approach stemming from the lack of a unified legal framework has resulted in disparate rules across jurisdictions, complicating cross-border collaborations and amplifying the risk of conflicting regulations. This regulatory discord not only hampers the efficiency of obtaining licenses for launches and satellite deployments but also poses considerable challenges in addressing liability concerns related to accidents or space debris. The absence of national space laws has created a regulatory void, hindering the development and harmonization of a robust framework for the flourishing commercial space sector[44].

The legal framework governing space endeavors, originating from international treaties and principles established during the 1960s and 1970s, requires effective coordination between national and international entities. Governments hold liability under international space law for activities originating from their territories, even when conducted by private entities. The surge in commercial space activities since the 1980s necessitates a harmonized approach to regulation, with national space laws serving as a complement to international agreements[45]. Countries, including Italy, have enacted legislation governing space activities within the framework of international treaties. Institutional coordination, as seen in the role of the International Telecommunication Union (ITU) in spectrum allocation, becomes crucial as the number of private actors increases. This coordination helps mitigate interference risks and ensures adherence to global standards. In Italy, recent legislative measures and the coordination efforts of the Italian Space Agency exemplify how institutional collaboration is essential for fostering a competitive and well-regulated private space industry[46].

The United States Space Command, serves as the warfighting combatant command responsible for employing forces from the U.S. Army, Marine Corps, Navy, Air Force, and Space Force. Headquartered in Colorado Springs, Colorado, with personnel across various bases, USSPACECOM

[44] Peters, A. (2017). The refinement of international law: From fragmentation to regime interaction and politicization. *International Journal of Constitutional Law, 15*(3), 671–704. https://doi.org/10.1093/icon/mox056

[45] Halunko, V. (2019). Space Law: The Present and the Future. *Advanced Space Law, 3*(3), 30-47. https://doi.org/10.29202/asl/2019/3/3

[46] Frieden, R. (2019). The evolving 5G case study in spectrum management and industrial policy. *Telecommunications Policy, 43*(6), 549-562. https://doi.org/10.1016/j.telpol.2019.04.001

actively conducts operations in space to deter conflict, defeat aggression, and protect U.S. vital interests. With a focus on space superiority, the command ensures the Joint Force's ability to swiftly transition from competition to conflict, asserting dominance in a global, all-domain fight[47]. The space power becomes increasingly integral to society and national security, USSPACECOM collaborates with allies and partners to plan, execute, and integrate military spacepower, emphasizing deterrence, defense, and the ability to prevail in the event of aggression, reinforcing the critical role of space in maintaining a competitive advantage for the United States[48].

COMSPOC stands at the forefront of space technology, pioneering the field of Space Situational Awareness (SSA) with its cutting-edge solutions. The world's premier commercial SSA center, it developed by Analytical Graphics, Inc. (AGI), leverages a global network of commercial sensors to deliver unparalleled accuracy and responsiveness[49]. The Commercial Space Operations Center (ComSpOC™) operates as a beacon of safety in space, diligently tracking tens of thousands of satellites, including undisclosed ones, to monitor threats and ensure the sustainability of space operations. With a diversified sensor network comprising optical technologies that offer both cost-effectiveness and versatility, it excels in curating, fusing, and processing sensor measurements, transforming SSA data into actionable information. Additionally, the cloud-based space situational awareness command center underscores commitment to providing timely and precise services for spaceflight safety, mission assurance, and national security. AGI's strategic spin-off in 2014 marked the establishment of Comspoc Corp, reinforcing its dedication to addressing challenges in the dynamic space environment[50].

---

[47] Galbreath, C. S. (2023, June). *Building U.S. Space Force Counterspace Capabilities: An Imperative for America's Defense* (Vol. 42). Mitchell Institute. https://mitchellaerospacepower.org/wp-content/uploads/2023/06/Building-US-Space-Force-Counterspace-Capabilities-FINAL2.pdf

[48] Priebe, M., Ligor, D. C., McClintock, B., Spirtas, M., Schwindt, K., Lee, C., Rhoades, A. L., Eaton, D., Hodgson, Q. E., & Rooney, B. (2020). *Multiple Dilemmas: Challenges and Options for All-Domain Command and Control*. Santa Monica, CA: RAND Corporation. https://www.rand.org/content/dam/rand/pubs/research_reports/RRA300/RRA381-1/RAND_RRA381-1.pdf

[49] Garber, S., & Herron, M. (2020, June 8). How has traffic been managed in the sky, on waterways, and on the road? Comparisons for space situational awareness (part 1). The Space Review. https://www.thespacereview.com/article/3961/1

[50] Hitchens, T. (2020). Norm Setting and Transparency and Confidence-Building in Space Governance. In C. Steer & M. Hersch (Eds.), *War and Peace in Outer Space: Law,*

In 2023, the landscape of space exploration witnessed a paradigm shift with private spaceflight companies playing a pivotal role in propelling the sector forward. Notably, Space Adventures and SpaceX emerged as trailblazers in orbital space tourism, orchestrating flights to Earth's orbit. Space Adventures, in collaboration with Russia, utilized the Soyuz spacecraft to transport ultra-wealthy individuals to the International Space Station[51]. The year marked a historic streak, with new world records set for both orbital launch attempts (223) and successful orbital launches (211). This continued trend underscores the escalating prominence of private entities in shaping the future of space travel. The roots of private space transportation date back to OTRAG, a German company founded in 1975, which pioneered private spacecraft launch attempts in the late 20th century. The space tourism gains momentum, companies like Virgin Galactic and SpaceX are poised to turn outer space exploration into a tangible reality[52].

The Office of Space Commerce, as the primary entity overseeing space commerce policy activities within the Department of Commerce, adheres to the foundational principles of transparency, public consultation, and stakeholder engagement inherent in the US regulatory system. Committed to fostering economic growth and technological advancement in the U.S. commercial space industry, the Office envisions a robust and responsive national sector that stands as a global leader in space commerce. Aligned with the Department of Commerce Strategic Plan for 2022-2026, the Office coordinates efforts to advance U.S. leadership in the global commercial space industry. Through its focus areas, including satellite navigation, commercial remote sensing, space transportation, and entrepreneurial activities, the Office not only participates in government-wide discussions on space policy but also contributes to internal initiatives aimed at enhancing NOAA's utilization of commercial space solutions[53].

Policy, and Ethics. ETHICS NATIONAL SECURITY RULE LAW SERIES. Oxford Academic. https://doi.org/10.1093/oso/9780197548684.003.0003

51 Yazici, A. M., & Tiwari, S. (2021). Space tourism: An initiative pushing limits. *Journal of Space Tourism*, *3*(1), 38-46. https://dergipark.org.tr/en/download/article-file/1514157

52 Sercel, J. C., Peterson, C. E., Britt, D. T., Dreyer, C., Jedicke, R., Love, S. G., & Walton, O. (2018). Practical Applications of Asteroidal ISRU in Support of Human Exploration. In *Primitive Meteorites and Asteroids: Physical, Chemical and Spectroscopic Observations Paving the Way to Exploration* (pp. 477-524). https://doi.org/10.1016/B978-0-12-813325-5.00009-4

53 Vedda, J. A. (2018, July). Remaking U.S. regulation of space commerce. Center for Space Policy and Strategy. https://aerospace.org/sites/default/files/2018-07/Remaking-US-Regulation%200718.pdf

The National Environmental Policy Act (NEPA) serves as a cornerstone in the United States' commitment to fostering a balanced and symbiotic relationship between humanity and its environment. Enacted to declare a national policy, NEPA aims to encourage a harmonious coexistence that promotes both productivity and enjoyment while safeguarding the health and welfare of individuals[54]. Central to this regulatory framework is the Environmental Impact Statement (EIS), a government document designed to comprehensively delineate the potential consequences of proposed projects on their surrounding ecosystems. In the realm of commercial space transportation, the Office of Commercial Space Transportation (FAA/AST) operates as a crucial arm of the Federal Aviation Administration (FAA). Tasked with approving commercial rocket launch operations, FAA/AST ensures the protection of public interests, property, and national security during these activities, emphasizing a commitment to both safety and the advancement of U.S. commercial space exploration[55].

NASA's strategic decision to engage in public-private partnerships with companies like SpaceX and Boeing for the Commercial Crew program marks a commendable shift in space exploration policy[56]. Rather than passively waiting for solutions, it actively invested in fostering a new industry, akin to the U.S Postal Service's role in nurturing the private airline sector during the early 20th century. The supporting SpaceX and Boeing, it aimed to address the challenge of accessing the ISS, paving the way for a more cost-effective space exploration approach. The success of the Commercial Crew program hinges on the reliable delivery of astronauts to the ISS by these private entities. Now, as it extends this approach to the Artemis program's crewed lunar lander, it faces a more intricate project with political hurdles. Nevertheless, the commitment to experimentation and prudent policy in reducing spaceflight costs, exemplified by the Commercial Crew initiative, remains a promising trajectory for the future of space exploration[57].

---

54 Silecchia, L. A. (2004). Environmental Ethics from the Perspectives of NEPA and Catholic Social Teaching: Ecological Guidance for the 21st Century. *William & Mary Environmental Law and Policy Review, 28*(3), 659. https://scholarship.law.wm.edu/wmelpr/vol28/iss3/3

55 Davidian, K. (2017). Safety research at the U.S. FAA center of excellence for commercial space transportation. *Journal of Space Safety Engineering, 4*(2), 64-76. https://doi.org/10.1016/j.jsse.2017.06.001

56 Lee, D. D. (1984). Herbert Hoover and the Development of Commercial Aviation, 1921-1926. *The Business History Review, 58*(1), 78–102. https://doi.org/10.2307/3114529

57 Von Ehrenfried, M. "Dutch". (2020). *The Artemis Lunar Program: Returning People*

NASA's Commercial Resupply Services (CRS) program marks a significant shift in space exploration, fostering fruitful collaborations with American companies such as SpaceX and Northrop Grumman (formerly Orbital ATK). Commencing just over two years post the conclusion of the Space Shuttle Program, these partnerships have proven instrumental in restoring America's capability to independently deliver and return cargo to the International Space Station (ISS). Through the Commercial Orbital Transportation Services (COTS) initiative, SpaceX and Northrop Grumman developed rockets and spacecraft, securing contracts from NASA for reliable cargo transportation[58]. This strategic alliance not only ensures a steady supply chain to the ISS but also facilitates the reuse of NASA facilities, such as the Kennedy Space Center and Wallops Flight Facility. It embracing public-private partnerships, NASA is not only achieving safe and cost-effective cargo missions but also paving the way for a robust American commercial space industry, freeing resources for the development of next-generation space exploration technologies[59].

The Artemis program represents a groundbreaking era in space exploration, with NASA's ambitious goal of landing the first woman and first person of color on the Moon. Through innovative technologies and collaboration with commercial and international partners, Artemis aims to explore more of the lunar surface than ever before. This lunar exploration serves multiple purposes, including scientific discovery, technological advancement, and the crucial preparation for future human missions to Mars. The program's impressive performance is evident in its significant economic impact, generating nearly $2.2 billion in tax revenue, contributing approximately $20 billion to the overall economy, and creating 37,000 jobs nationwide. The Artemis strives to establish the first long-term presence on the Moon, it not only marks a historic achievement in diversity and space exploration but also propels humanity toward a future where living and working on another world becomes a reality[60].

to the Moon. Springer Cham. https://doi.org/10.1007/978-3-030-38513-2

[58] Grande, M. L., Carrier, M., Cirillo, W., Earle, K. D., Jones, C. A., Judd, E., Klovstad, J. J., Owens, A. C., Reeves, D., & Stafford, M. (2018). Mega-Drivers to Inform NASA Space Technology Strategic Planning. *AIAA 2018-5137*. Session: Space Strategy I. Published Online: 15 Sep 2018. https://doi.org/10.2514/6.2018-5137

[59] Stein, A. D. (2013). *Meet Them Where They Gather: An Analysis of NASA's Communications Approach for the 21st Century* (Master's thesis). Theses from the College of Journalism and Mass Communications. University of Nebraska-Lincoln. https://digitalcommons.unl.edu/journalismdiss/31

[60] Gloria Oladipo and agency (2023, June 28). NASA aims to mine resources on the

The Biden-Harris Administration's new United States Novel Space Activities Authorization and Supervision Framework represents a significant step forward in regulating the burgeoning commercial space sector. Acknowledging the inadequacies of existing regulations in addressing novel space activities, the framework, along with the proposed legislation, empowers the Departments of Commerce and Transportation to oversee these activities effectively[61]. It aligning rulemaking timelines, fostering international collaboration, and creating a knowledge repository, the framework aims to guide private sector space activities while prioritizing safety, security, and long-term sustainability. The establishment of a standing Private Sector Space Activities Interagency Steering Group underscores a commitment to informed policymaking. This approach recognizes the rapid innovation within the U.S. space private sector and underscores the importance of collaboration between the government and private entities to achieve shared objectives, including space exploration, national security, climate crisis mitigation, and international partnerships. Ongoing cooperation will be essential to align governmental and private sector interests effectively[62].

The prevailing notion often underscores the significant role of government funding in advancing space exploration, contrasting it with the more recent emergence of private investment. A historical analysis, particularly in the United States, challenges this perception, revealing that private funding for space exploration has been more of a norm than an exception[63]. While the belief in the early years of the "Space Race" fostering substantial economic growth is widespread, empirical evidence is limited. Referencing a study in this Special Feature, spanning the 1960s to the present, reveals that space activities indeed yield positive economic spillovers, with varying intensities over time. The 1960s and 1970s witnessed significant positive impacts on GDP growth, contrasting

moon in the next decade. *The Guardian*. https://www.theguardian.com/science/2023/jun/28/nasa-mining-moon-2032

[61] Sundahl, M. J. (2019). Business, Legal, and Policy Issues in Relation to Increased Private Space Activity. Retrieved from https://doi.org/10.1093/acrefore/9780190647926.013.76

[62] Inzunza Higuera, G. (2022). What Got Us Here, Won't Get Us There: Why U.S. Commercial Space Policy Must Lie in an Independent Regulatory Agency. *Hastings Law Journal, 73*(1), 105. https://repository.uclawsf.edu/cgi/viewcontent.cgi?article=3957&context=hastings_law_journal

[63] Van Drie, J., & van Boxtel, C. (2008). Historical reasoning: Towards a framework for analyzing students' reasoning about the past. *Educational Psychology Review, 20*(1), 87–110. https://doi.org/10.1007/s10648-007-9056-1

with the comparatively smaller effects since the 1980s when public space investment dwindled. These findings offer insights for policymakers in high-income economies seeking growth stimuli and underscore the importance of further research on public space spending and its role in broader economies[64].

The December 2020 National Space Policy (NSP) mandates the Department of State, in collaboration with other Executive Branch entities, to execute diplomatic and public diplomacy initiatives aimed at fortifying global comprehension and backing for U.S. space policies and programs. Aligned with the December 2021 United States Space Priorities Framework and the October 2022 National Security Strategy, the U.S. commits to advancing a rules-based international order for outer space activities, emphasizing responsible and sustainable space use. This mission aligns with Space Policy Directives and other national strategies, reflecting the broader objectives outlined in the FY 2022-2026 State-USAID Joint Strategic Plan and national policies on cybersecurity, counterterrorism, gender equity, and critical infrastructure security. Grounded in the Department's overarching mission of safeguarding U.S. security, prosperity, and democratic values, the space diplomacy endeavors aim to shape an international environment conducive to the well-being of all Americans[65].

Public-private collaboration in advancing the US commercial space sector, exemplified by the success of the International Space Station (ISS) National Laboratory. Through strategic partnerships with entities like the Center for the Advancement of Science in Space and private research facility operators such as NanoRacks, BioServe, TechShot, Made In Space, and Space Tango, the ISS National Lab has transformed into a dynamic hub for innovation[66]. The collaboration model, facilitated by bipartisan legislation, has diversified funding sources, attracting over $20 million in third-party funding in the past two years alone. This approach not only

[64] Corrado, L., Cropper, M., & Rao, A. (2023). Space Exploration: Economics, Technologies, and Policies. *Proceedings of the National Academy of Sciences of the United States of America, 120*(43), e2221341120. https://doi.org/10.1073/pnas.2221341120.

[65] National Institute for Public Policy. (2023). Expert Commentary on the 2022 National Security Strategy (Vol. 3, No. 2). Edited by Michaela Dodge and Matthew R. Costlow. National Institute Press. https://nipp.org/wp-content/uploads/2023/01/OP-Vol-3-No.-2.pdf

[66] Wood, J., Wood, C., & Wood, D. (2019). Understanding SocioTechnical Issues Affecting the Current Microgravity Research Marketplace. *2019 IEEE Aerospace Conference*, March 2019, Big Sky, Montana, USA. Institute of Electrical and Electronics Engineers.

accelerates space-based research but also fosters a competitive marketplace for space services, with leading the way. The demand for space research grows, the public-private collaboration model proves instrumental in driving economic value, scientific advancements, and the emergence of a robust low Earth orbit market[67].

The celebrated success of SpaceX's Falcon 9 rocket comes with an environmental cost that raises concerns about the impact of space travel on our planet. The Falcon 9, along with other global rocket launches, injects approximately 1,000 tons of soot into the stratosphere annually, as revealed by a study from the National Oceanic and Atmospheric Administration (NOAA)[68]. This soot, a byproduct of burning kerosene, lingers in the upper atmosphere for up to five years, absorbing heat and contributing to climate change while posing a threat to the ozone layer. Despite the relatively small contribution of rocket launches to overall atmospheric pollutants compared to the aviation industry, the unique atmospheric dynamics of the stratosphere exacerbate the environmental consequences. The industry expands, NOAA warns of potential harm to people in the Northern Hemisphere due to increased exposure to harmful UV radiation. Addressing these concerns becomes imperative as the environmental impact of space travel becomes more evident[69].

The regulatory framework for environmental concerns related to commercial space activities in the United States is characterized by a complex interplay of agencies and evolving policies. The National Environmental Policy Act (NEPA) guides the environmental impact assessment for launches, but its efficacy is influenced by regulatory changes[70]. While the Federal Aviation Administration (FAA) oversees NEPA

[67] Quan, X., & Solheim, M. C. W. (2023). Public-private partnerships in smart cities: A critical survey and research agenda. *City, Culture and Society, 32*, 100491. https://doi.org/10.1016/j.ccs.2022.100491

[68] Ryan, R. G., Marais, E. A., Balhatchet, C. J., & Eastham, S. D. (2022). Impact of Rocket Launch and Space Debris Air Pollutant Emissions on Stratospheric Ozone and Global Climate. *Earth's Future, 10*(6), e2021EF002612. https://doi.org/10.1029/2021EF002612

[69] Williamson, C. E., Madronich, S., Lal, A., et al. (2017). Climate change-induced increases in precipitation are reducing the potential for solar ultraviolet radiation to inactivate pathogens in surface waters. *Scientific Reports, 7*(1), 13033. https://doi.org/10.1038/s41598-017-13392-2

[70] Struthers, C. L., Murenbeeld, K. J., & Williamson, M. A. (2023). Environmental impact assessments not the main barrier to timely forest management in the United States. *Nature Sustainability, 6*(12), 1542–1546. https://doi.org/10.1038/s41893-023-01218-1

compliance for space launches, recent rule alterations, including Trump-era rollbacks, have created uncertainties. The Environmental Protection Agency (EPA) regulates atmospheric emissions but faces challenges in establishing baseline data for spaceflight. NASA and NOAA contribute vital information but maintain a non-prescriptive role. The regulatory landscape is further complicated by categorical exclusions, lax interpretations, and potential shifts depending on political dynamics. Balancing environmental protection with fostering a burgeoning commercial space sector remains a delicate challenge, emphasizing the need for a comprehensive and adaptive regulatory approach[71].

In a significant incident, satellites from OneWeb and SpaceX's Starlink narrowly avoided a collision in orbit, marking the first known collision avoidance event between the rival companies. The US Space Force's 18th Space Control Squadron issued red alerts, indicating a 1.3 percent collision probability and a close approach of 190 feet. The urgency prompted OneWeb to coordinate with SpaceX to maneuver its satellite away, during which SpaceX disabled its automated AI-powered collision avoidance system. The incident underscores the lack of a global authority regulating satellite operators in such situations. With the rapid increase in satellite deployments, especially by companies like SpaceX and OneWeb, the need for clear rules and coordination in orbit becomes increasingly crucial to prevent potential collisions and space debris issues. The satellites do separate out after they are released, but the reason there are so many is to provide coverage to as many people as possible and to cater for growth in data traffic. They are only that close together in the period soon after their release from the launch vehicle[72].

The Committee on the Peaceful Uses of Outer Space (COPUOS) shaping the regulatory landscape for international collaborations in space exploration. With the increasing complexity of partnerships involving government agencies, private companies, and international organizations, regulatory frameworks must adapt to accommodate diverse interests and capabilities. The exchange of extensive data during collaborative space missions necessitates careful consideration of regulatory aspects related to data sharing, privacy, and security. The growing interest in resource

[71] Morgan, R. K. (2012). Environmental impact assessment: the state of the art. *Impact Assessment and Project Appraisal, 30*(1), 5-14. https://doi.org/10.1080/14615517.2012.661557

[72] McDowell, J. C. (2020). The Low Earth Orbit Satellite Population and Impacts of the SpaceX Starlink Constellation. *The Astrophysical Journal Letters, 892*(2), L36. https://doi.org/10.3847/2041-8213/ab8016

utilization, such as mining asteroids and exploiting lunar resources, calls for international agreements addressing ownership, extraction rights, and responsible resource use. Space debris management, legal jurisdiction boundaries, technology transfer, ethical considerations, and geopolitical dynamics further underscore the need for robust regulatory frameworks[73].

The burgeoning private space industry, with over 10,000 firms and 5,000 investors, is generating significant economic benefits. The Space Foundation's 2022 report reveals that the space economy, valued at $469 billion in 2021, has experienced a 9% annual growth. Private sector contributions surpass public funding, with more than $224 billion generated by space companies. A "space renaissance" marked by technological innovation has dramatically reduced rocket launch costs, making space endeavors financially feasible for a broader range of entities. The CEO of Planet Labs highlights a fourfold drop in rocket prices over the past decade, resulting in a tenfold increase in Earth imagery production and communication bandwidth. These advancements not only foster growth within the space sector but also catalyze efficiency across diverse industries, including meteorology, energy, telecommunications, insurance, and agriculture[74]. Top of Form

Commercial space activities present a myriad of ethical considerations as the landscape of space exploration evolves. The burgeoning presence of low Earth orbit (LEO) satellites, while offering improved communication and weather tracking, raises questions about the regulation of space, especially concerning fairness, safety, and the impact on stargazing[75]. The historical example of Wernher von Braun, who was involved in the development of Nazi V-2 rockets and later contributed to the Apollo program, highlights the ethical challenges associated with employing individuals with questionable backgrounds for strategic gains[76]. The ethical

---

[73] De Zwart, M., Henderson, S., & Neumann, M. (2023). Space resource activities and the evolution of international space law. *Acta Astronautica, 211*, 155-162. https://doi.org/10.1016/j.actaastro.2023.06.009

[74] Bernasconi, M. C., & Bernasconi, C. (2004). Why implementing the space option is necessary for society. *Acta Astronautica, 54*(5), 371-384. https://doi.org/10.1016/S0094-5765(03)00060-2

[75] Rummel, J.D., Race, M.S., & Horneck, G. (2012). Ethical Considerations for Planetary Protection in Space Exploration: A Workshop. *Astrobiology*, *12*(11), 1017–1023. https://doi.org/10.1089/ast.2012.0891

[76] Neufeld, M. J. (2002). Wernher von Braun, the SS, and Concentration Camp Labor: Questions of Moral, Political, and Criminal Responsibility. *German Studies Review*, *25*(1), 57–78. https://doi.org/10.2307/1433245

dilemma extends to the sequence of scientific, strategic, and commercial interests, urging a balance between exploration motivations and potential risks, such as contamination and space debris. The lack of a centralized ethical framework underscores the importance of clear guidelines to determine permissible and prohibited activities, promoting transparency, and addressing concerns about the allocation of resources between space endeavors and Earth's well-being. As space exploration advances, ethical reflection becomes imperative to ensure responsible and principled engagement in the commercialization of outer space[77].

5. *Conclusion*

The landscape of outer space exploration and utilization transforms with the ascendancy of private sector enterprises, adequate regulatory frameworks attuned to this commercialization wave become imperative across jurisdictions - particularly in developing countries. Robust, efficient and flexible policy regimes and institutional mechanisms modeled on demonstrated successes like the United States fosters sustained advancement of indigenous space industries in the Global South. This paper has examined the pioneering commercial space governance architecture established by the US since the 1980s encompassing visionary national policies, legislature streamlining licensing, liability stipulations shielding emerging operators and overarching institutional coordination. In contrast, severe deficiencies plague regulatory structures across developing countries as evident through absence of national space laws, outdated liability clauses rooted in erstwhile state-centric regimes, bureaucratic procedural complexities and lack of technical capacity in regulator workforces.

These limitations significantly throttle private investment, escalate market entry barriers through protracted approval processes and amplify opportunity costs - all constraining innovation and growth within high-technology sectors like commercial space despite the promise of this domain. As the wave of new space age accelerates globally, developing countries stand to lose out substantially from the ballooning economic activity and technological spin-offs materializing from advanced space

[77] Pompidou, A. (2000, April 20). The Ethics of Space Policy. Co-ordinator of the Working Group on the "Ethics of Outer Space" set up by the UNESCO World Commission on the Ethics of Scientific Knowledge and Technology (COMEST). Reykjavik. https://unesdoc.unesco.org/ark:/48223/pf0000120681

systems and services. However, through proactive regulatory reforms localized to their ground realities and policy priorities, these countries can partake more meaningfully in the expanding global space economy. This requires national space legislations establishing coordination bodies, licensing and liability protocols attuned to entrepreneurial space ventures and streamlined bureaucratic procedures granting approvals based on expertise rather than administrative precedent.

A specialized technical workforce development, incentives attracting private capital and tiered opening of select industry verticals easing regulatory transition offer pathways for developing countries to advance commercial space ambitions. Importantly, retaining public sector guidance and oversight through collaborative institutional mechanisms as opposed to outright privatization, underscores strategic interests and welfare considerations in a sector laden with national security and international treaty imperatives. It cautiously learning from US legal principles and regulatory approaches underlying the pronounced success of its private space industry, while customizing suitably - developing countries can erect responsive policy regimes and governance systems enabling sustainable growth of commercial space activities from their territories. This promises substantial economic, technological and prestige dividends besides charting a progressive growth trajectory for indigenous space industries in the 21st century. The potential gains from proactive regulatory reforms and institutional changes are too monumental to overlook even as the window of opportunity continues closing rapidly.

The recommendations include developing national space legislations modeled on US laws, streamlining licensing and authorization frameworks, building technical capacity for regulation, formulating proactive policy directives and incentives to boost private space investments, enhancing inter-agency coordination and ensuring participative decision-making. It providing robust, transparent, efficient and flexible regulatory frameworks for commercial space activities that also address local constraints, developing countries can gain immensely from the expanding global space economy. The thoughtful and contextual localization of relevant aspects of US policy, legal and regulatory approaches will assist developing countries in catalyzing the sustainable advancement of private space enterprises.

Mario Pasquale Amoroso

Troubling Technologies in Outer Space: How to Hold States Accountable for Military Activities in Orbit

Summary: 1. Introduction – 2. The weaponisation of orbits: features and uses of space military technologies – 3. The regime of international responsibility for national activities in outer space – 4. An (apparent) risky legal lag: an examination of the international regime regulating military activities in outer space – 5. Conclusions.

1. *Introduction*

On 15 February 2024, the US intelligence briefed the national security spokesman, John Kirby, on evidence of Russia's development of a new space-based nuclear anti-satellite weapon, a programme described as 'troubling' despite the absence of any 'immediate threat to anyone's safety'[1]. This information, that immediately leaked to the British media[2], raised obvious security concerns and prompted the US House Intelligence Committee to call on President Biden to declassify information on this and other space threats[3]. Despite the uncertainty about the nature of the threat, the call for immediate responses is indicative of the sensitivity of interstate relations in outer space, an area considered crucial to maintaining military and strategic superiority in the international arena.

In fact, this is only the latest in a series of (alleged) offensive activities enacted by Russia in outer space, which along with China and the US, is

[1] J. Borger, *White House confirms monitoring of 'troubling' Russian anti-satellite weapon,* The Guardian, 15 February 2024, [https://www.theguardian.com/us-news/2024/feb/15/russia-anti-satellite-weapon-space-white-house].

[2] B. Debusmann Jr., *Top Republican's cryptic warning of US 'national security threat',* BBC News, 15 February 2024, [https://www.bbc.com/news/world-us-canada-68296879].

[3] *Russia 'developing space-based nuclear weapon' to target US satellites, sparking security concerns,* SkyNews, 16 February 2024, [https://news.sky.com/story/republican-warns-of-national-security-threat-amid-fears-of-russian-space-weapon-13071884].

one of the major space-faring nations with launch capabilities. In February 2020, the commander of the US Space Force, John Raymond, announced that two Russian satellites had begun to tail an American spy satellite, an 'unusual and disturbing behaviour', with a clear provocative intention[4]. In addition, China, along with Russia, is challenging the US power in outer space by developing and testing an extensive arsenal of weapons that could potentially destroy or disable US satellites on which the US relies to provide essential services to its citizens[5]. These tensions led the former President, Donald Trump, to declare space as a w*ar-fighting domain* not safe from the outbreak of international conflicts[6], also taking into account how new actors, such as India and Iraq, have joined the space superpowers by testing new military technologies in orbit[7].

The arms race in the outer space demonstrates the interest of States in gaining control of a domain that has become the new frontier for the projection of States' power. This can be explained in light of the military and strategic advantages that access to and control of the outer space can provide on Earth. Satellites, in particular, have come to play a critical role for several functions in the security sector, such as positioning, missile interception, and communications. This exposes them to the targeting activities of States wishing to acquire information and military superiority within the international community and explains the crowding of orbits by the most powerful nations with more developed anti-satellite (ASAT) systems.

This process of weaponisation of space has not yet led to the outbreak of hostilities that would constitute an armed conflict as defined by the 1949 Geneva Conventions[8]. International humanitarian law (IHL) applies

---

[4] W.J. Henningan, *Exclusive: Strange Russian Spacecraft Shadowing U.S. Spy Satellite, General Says,* TIME, 10 February 2020, [https://time.com/5779315/russian-spacecraft-spy-satellite-space-force/]

[5] C. Kube, D. De Luce, *How China is challenging the U.S. military's dominance in space,* NBC News, 13 December 2023, [https://www.nbcnews.com/politics/national-security/china-challenging-us-militarys-dominance-space-rcna128993].

[6] *Space Force: Trump officially launches new US military service*, BBC, 21 December 2019, [https://www.bbc.com/news/world-us-canada-50876429].

[7] S. Singh, India joins super space club with launch of anti-satellite missile, The Times of India, 27 March 2019.

[8] Geneva Convention for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field (GC I), 12 August 1949, 75 UNTS 31, (1949), Art. 2.1: " The present Convention shall apply to all cases of declared war or of any other armed conflict which may arise between two or more of the High Contracting Parties, even if the state of war is not recognized by one of them". The text is reproduced in the same terms also in the other Geneva Conventions.

to 'all forms of warfare and to all kinds of weapons'[9], therefore including ASAT weapons, and States Parties to the Geneva Conventions undertake to respect and to ensure respect for it in all circumstances[10], confirming the potential applicability of IHL to armed activities in outer space. Yet, for an international armed conflict to exist, there must be hostilities between the armed forces of two or more States, although without any threshold of intensity[11]. Since States have not yet entered into hostilities with each other and are only involved in testing and positioning new technologies, the application of IHL to military activities currently taking place in outer space should be excluded.

Nevertheless, expansionist ambitions have led States to deploy new weapons systems in orbit, only some of which are programmed to destroy space objects. While "kinetic" anti-satellite weapons are clearly designed to collide with other satellites and cause material damage, States have begun to develop new technologies aimed at temporarily or permanently disabling the functioning of satellites without destroying them. The use of such technologies would doubtfully amount to hostilities under the Geneva Conventions[12]; yet, it can give rise to international responsibility for harmful activities under the Outer Space Treaty[13] and other relevant legal regimes.

The purpose of this paper is therefore to define which of the hostile activities in outer space that take place outside the context of an armed conflict could still be of concern to States as a source of international responsibility. To this end, an overview of the most important space weapons developed by States will be provided (Section 2), followed by an examination of the regime of responsibility established in the Outer Space Treaty (Section 3). In conclusion, the provisions limiting the recourse to ASAT weapons, both within and outside the outer space legal regime, will

[9] International Court of Justice (ICJ), *Legality of the Threat or Use of Nuclear Weapons,* Advisory Opinion, 8 July 1996, §86.

[10] GC I, Article 1. The text is reproduced in the same terms also in the other Geneva Conventions.

[11] The ICRC commentary proposes this position, known as the 'first shot theory': J. Pictet, *Commentary on the Geneva Conventions of 12 August 1949*, Vol. IV, (1952), pp. 20-21; ICRC*, Updated Commentary on the Geneva Conventions of 12 August 1949*, Vol. I, (2016), par. 218.

[12] E. Pobjie, Outer Space, Military Uses of, MPEPIL, 2024, §33.

[13] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 10 October 1967, 610 UNTS 205, Article VI.

be analysed in order to verify whether States could be held accountable for the recourse to these technologies (Section 4).

2. *The weaponisation of orbits: features and uses of space military technologies*

Space is currently populated by various technologies programmed to perform hostile functions, and the resulting congestion of the orbits has increased the likelihood of conflicts. The placement of new weapons systems in orbit has been recently driven by the will of some States to disrupt the functioning of satellites, which are essential for the provision of certain key services, particularly military ones. Space systems used to this end fall into the category of "anti-satellite weapons" (ASAT weapons), i.e. "weapons designed to destroy or disable a satellite in space by nuclear or conventional explosion, collision at high speed, or directed energy beam"[14]. These technologies can be easily classified as "space weapons", i.e. technologies with the destructive potential of objects positioned in space[15]. Although not all of them are programmed to materially destroy other space objects States could be held responsible for interfering with the interests of other States by resorting to technologies that disable satellite functions, such as electronic weapons. These new systems have led to an expansion of the category of ASAT weapons: it may thus be relevant to start with an overview of technologies designed to perform hostile functions against satellite systems, in order to have a complete picture of military activities in outer space that could determine international responsibility.

a. From land to space battlefield: the development and different uses of ASAT weapons

Since the beginning of the process of exploration of outer space, global superpowers started positioning and testing nuclear warheads in outer space, delivered through intercontinental ballistic missiles (ICBMs)[16]. The United States and the Soviet Union started these operations immediately

[14] United Nations Institute for Disarmament Research Geneva, *Prevention of an Arms Race in Outer Space: A Guide to the Discussions in the Conference on Disarmament*, New York. 1991, p. 177.

[15] B. Jasani, *Peaceful and non-peaceful uses of space: problems of definition for the prevention of an arms race*, New York, Taylor & Francis, 1991.

[16] R.A. Ramey, 'Armed Conflict on the Final Frontier: The Law of War in Space' in *The Air Force Law Review,* 48(2000), 2000, p. 12.

after the launch of the first artificial satellite, Sputnik 1, showing interest in asserting their presence in what was then a completely unexplored area[17]. However, the detonation of nuclear weapons in outer space immediately raised concerns about the long-term effects it could have on the space environment. Indeed, the electromagnetic pulse generated by the explosion would cause the widespread destruction of satellite circuits, rendering them inoperable, with catastrophic consequences for terrestrial computing and communications infrastructures[18]. In addition, the electromagnetic radiation would cause environmental damage, most commonly associated with the formation of an artificial radiation belt around the Earth, potentially affecting the operability of electronics operating in the Earth's orbit[19]. These catastrophic consequences led States to establish clear legal prohibitions on the use of these weapons in outer space, such as those established in Article IV of the Outer Space Treaty that will be briefly analysed. However, the recent allegation, mentioned above, that Russia is developing nuclear-capable ASAT weapons could reopen debates on the use of these systems in the space context, in particular with regard to the potential violations of international law that could result from their positioning in orbit.

Similar legal prohibitions have not been clearly established in relation to other weapons systems that have crowded the orbits since the first explorations of outer space and have been frequently tested by States, i.e. kinetic ASAT weapons. These technologies belong to the category of hard-kill weapons, i.e. weapons designed to destroy their target by means of a high-speed impact or explosion[20]. This destruction results in the release of space debris, which are likely to damage other civilian satellites as they travel at high speed in the Earth's orbit, potentially rendering them unusable for extended periods of time[21]. A wide range of different kinetic ASAT weapons

[17] C. Gainor, 'The Nuclear Roots of the Space Race' in *Militarizing Outer Space: Astroculture, Dystopia and the Cold War,* Palgrave McMillan, Vol. 3, 2021, p. 72.

[18] M. Peel *et al., How could nuclear weapons be used in space?,* Financial Times, 25 February 2024, [https://www.ft.com/content/ea57d82c-e042-46d3-9989-ac1ef336766a].

[19] J. Loughran, *A singular nuclear explosion in space would threaten a 'significant proportion of satellites,* Engineering and Technology, 7 May 2024, [https://eandt.theiet.org/2024/05/07/singular-nuclear-explosion-space-would-threaten-significant-proportion-satellites].

[20] M. Bourbonniere, 'Law of armed conflict (LOAC) and the neutralisation of satellites or ius in bello satellitis' in *Journal of Conflict and Security Law,* 9(1), 2004, p. 56.

[21] D. Stephens, C. Steer, 'Conflicts in Space: International Humanitarian Law and its application to space warfare', in *McGill Annals of Air and Space Law,* XXXX (2015), 2015, p. 5.

have been developed in the early stages of space exploration, potentially resulting in the release of large amounts of debris. In particular, from the 1960', the Soviet Union started testing explosive proximity weapons, missiles launched in the same orbital plane of the target and controlled remotely in order to approach the target and explode in its proximity[22]. Similarly, States have also developed direct-ascent ASAT weapons, outfitted with conventional warheads, with the aim of targeting spacecrafts[23], and tested space mines, programmed to explode when entering in contact with the target or release shrapnel to damage a spacecraft[24].

The development of all these weapons systems shows how the need to control orbits has led to the advancement of space warfare since the first phases of the exploration of space, with the development of technologies that damage space objects without recourse to kinetic energy. This is the case of direct energy weapons, i.e. non-kinetic weapons using radiated energy, such as laser or microwave energy, to destroy, damage or interfere with space systems by heating their surface[25]. In particular, the first laser weapons, which used chemical reactions to produce concentrated radiation beams to hit targets at long ranges[26], were operational as early as 1980. The Mid-Infrared Advanced Chemical Laser (MIRACL), developed by the US Navy, was the first ground-based system tested in 1997 against the US Air Force's MSIT-3 satellite, causing only minor damage[27]. However, the distorting effect of passing through the Earth's atmosphere has led States to compete in the development of laser systems activated directly in the space domain, as demonstrated by the new French orbital space surveillance project, the FLAMHE, whose aim is to identify potential on-orbit threats to national assets, and if necessary, disable the threat with lasers mounted

[22] P.B. Stares, *Space and national security*, Washington, Brookings Institutional Press, 1987, p. 87.

[23] C. Swope *et al., Space Threat Assessment 2024,* Centre for Strategic and International Studies, April 2024, p. 3.

[24] *The Spectrum of Space Weaponry: An Examination of Potential Developments,* New Space Economy, 16 June 2023, [https://newspaceeconomy.ca/2023/06/16/the-spectrum-of-space-weaponry-an-examination-of-potential-developments/].

[25] C. Swope *et al., Space Threat Assessment 2024,* p. 4.

[26] W.H. Possel, *Laser weapons in space: a critical assessment*, Air War College, Alabama, AU/AWC /197/1998-04, pp. 18-19.

[27] C. Plante, *Pentagon beams over military laser test,* CNN, 20 October 1997, [https://web.archive.org/web/20071230052044/http://www.cnn.com/US/9710/20/pentagon.laser/].

on space objects[28].

All of the weapon systems described in this paragraph can have destructive effects on space targets as a whole or on individual components, potentially leading to the production of large amounts of space debris. Recently, however, new kinetic and direct energy weapons performing functions other than destructive ones are being developed.

b. From blinding to hacking: the new developments of space weaponry

International norms that set limits on State behaviour normally serve to deter behaviour that could harm the interests of other States or the international community as a whole. However, the pressing interest of some countries in gaining a competitive advantage in the process of space exploration and exploitation has led to the development of new weapons systems designed to avoid falling under existing prohibitions on the placement of certain weapons in space.

In fact, ASAT weapons have been adapted to pursue similar objectives, but by different means, in order to prevent satellites from performing their functions without causing their total or partial destruction. Among kinetic weapons, for example, we can find "orbital grapplers", i.e. technologies that physically manipulate the targeted satellite manoeuvring it to another location, thus rendering it inoperable[29]. Similarly, direct energy weapons, including laser weapons, which were originally designed to destroy spacecraft, are now being developed to perform new purposes, i.e. to 'dazzle' or blind satellite sensors, thus disabling their functions without creating space debris[30]. This is the case of the Peresvet, a laser weapon system designed to hit satellites from Earth in order to dazzle them and disable their functions[31].

The pace of technological development has led States more interested in controlling orbits to expand even more the range of hostile conducts that could be used to disrupt satellite functions. Among these, electronic interference can take several forms, all of which have a similar purpose, namely, to control the space electromagnetic spectrum, and thereby affect

---

28 V. Machi, *Macron sends $438 billion military budget plan to French parliament*, DefenseNews, 4 April 2023, [https://www.defensenews.com/global/europe/2023/04/04/macron-sends-438-billion-military-budget-plan-to-french-parliament/].

29 C. Swope *et al., Space Threat Assessment 2024,* p. 3.

30 M. Byers, A. Boley, 'Anti-satellite Weapons and International Law', in M. Byers, A. Boley, *Who Owns Outer Space,* CUP, 2023, p. 342.

31 B. Hendrickx, *Peresvet: a russian mobile laser system to dazzle enemy satellites,* The Space Review, 15 June 2023, [https://www.thespacereview.com/article/3967/1].

the satellite's ability to receive information from ground stations[32]. In particular, among these forms of interference, spoofing and jamming are those that States appear to be more interested in potentially employing to disrupt other states' space activities. While spoofing is the act of replicating or falsifying Global Positioning System (GPS) or communication signals in order to 'fool' a GPS device by manipulating its position, speed of movement and ability to measure time[33], jamming technologies transmit signals on the same radio frequency as the target but in the opposite direction, which can suppress or deceive the victim's GPS or communication receiver, making it unable to follow the signal for which it is programmed[34]. The use of these technologies on GPS satellites employed for military use could negatively affect the situational awareness of States involved in ongoing conflicts[35]. The prospect of States resorting to these technologies is not so far-fetched, as recent tragic historical events, such as the hostilities currently taking place in the Gaza Strip, show how GPS jamming has been used to disrupt Global Navigation Satellite Systems in order to support attacks on land[36].

Finally, the proper functioning of satellites could be hampered through cyber operations targeting space systems. In particular, offensive activities in cyberspace do not disrupt radio frequencies, but rather "target the data itself and the [satellite] system that uses, transmits and controls the flow of data" by intercepting or inserting false or corrupted data[37]. Cyber-attacks on space systems could result not only in the partial or total loss of data provided by a satellite, but also in more damaging consequences, such as the destruction or disabling of the internal machinery of satellites after remote control has been taken over, which could lead to the activation of

[32] US Joint Chiefs of Staff, *Electronic Warfare,* JP 3-13.1, 25 January 2007, I-2.

[33] M.L. Psiaki, T.E. Humphreys, 'GNSS spoofing and detection' in *Proceedings of the IEEE*, 104(6), 2016, p. 1258.

[34] L. Xiangjun *at al.,* 'Overview of Jamming Technology for Satellite Navigation', in *Machines,* 11(7), 2023, pp. 769 ff.

[35] E. Grey, *Satellites and spoofing – how hackers falsify situational awareness*, Army Technology, 17 November 2013, [https://www.army-technology.com/features/feature-satellites-spoofing-hackers-falsify-situational-awareness/?cf-view].

[36] M. Karlinski Zur, *Inside Israel's GPS jamming strategy in Gaza war,* Ynet News, 16 December 2023, [https://www.ynetnews.com/health_science/article/s1zex9ii6]; M. Berg, *Israel's using widespread GPS tampering to deter Hezbollah's missiles*, Politico, 23 October 2023, [https://www.politico.com/news/2023/10/23/israels-gps-tampering-deter-hezbollahs-missiles-00123026].

[37] T. Harrison, *Space Threat Assessment 2021,* Center for Strategic and International Studies, 2021, p. 5.

commands to self-destruct the electronic system or sensors[38]. Among others, China is suspected of being responsible for several cyber-attacks on foreign satellite networks, including remote sensing and weather satellites and Indian communications satellites[39].

Thus, the current picture of non-kinetic space weapons appears complex and diverse, making a clear classification of space weapon systems difficult and potentially subject to change in the near future. The next Section examines the regime of responsibility established in the 1967 Outer Space Treaty in order to understand whether (and when) recourse to the space weapons just described could lead to the establishment of international responsibility.

3. *The regime of international responsibility for national activities in outer space*

As early as 1963, just a few years after the beginning of the process of exploration of outer space, the General Assembly considered it urgent to emphasise the applicability of a regime of international responsibility for national activities in outer space[40]. This principle has been translated into the Outer Space Treaty, where the responsibility of States in the field of space activities takes a specific form, reflected in Articles VI and VII[41]. However, these two provisions establish two different regimes of responsibility.

Indeed, Article VII establishes a regime of objective liability of a State Party to the Outer Space Treaty that "launches or provides for the launching" of objects in outer space for the damage caused to other States Parties. Article VI, on the other hand, affirms the responsibility of States Parties for national activities not in conformity with the provisions of the Outer Space Treaty. This distinction is a fundamental premise for fully understanding which regime should be focused on when assessing international responsibility for military activities in orbit.

The special regime established in Article VII is interpreted by some

[38] M. King, S. Goguichvili, *Cybersecurity Threats in Space: A Roadmap for Future Policy,* CTRL Foreword, 8 October 2020, [https://www.wilsoncenter.org/blog-post/cybersecurity-threats-space-roadmap-future-policy].

[39] C. Swope et al., *Space Threat Assessment 2024,* p. 11.

[40] UNGA, *Declaration of Legal Principles governing the Activities of States in the Exploration and Use of Outer Space,* Res.1962 (XVIII), 13 December 1963, Principle 5.

[41] M. Pedrazzi, *Outer Space, Liability for Damage,* Max Planck Encyclopaedia of Public International Law (MPEPIL), 2008, §1.

scholars as a form of liability that is not linked to the commission of a wrongful act, but is simply applicable in cases of damage caused to other States Parties as a result of unintentional incidents[42]. Therefore, if this position is followed, Article VII, while applicable, is of limited relevance to the analysis presented in this paper, since recourse to certain weapons systems, such as weapons of mass destruction, constitutes an unlawful act, as does the use of other ASAT weapons.

In light of the foregoing, the relevant regime of international responsibility in the context of hostile activities in outer space has to be found in Article VI of the Outer Space Treaty. In particular, by establishing the international responsibility for all national activities of States Parties in outer space in contrast to the provisions of the Outer Space Treaty, this Article is an attempt to generalise the objective and subjective scope of international responsibility in the field of outer space law. In fact, it firstly applies irrespective of the actor, since international responsibility arises in the case of violations by both governmental and non-governmental actors. In addition, it recalls the provisions of the Outer Space Treaty, in particular those of Articles II to XII[43], establishing States responsibility for any of the national activities in contrast with these norms.

Moreover, as recalled in Article III of the Outer Space Treaty, States can be held responsible for intentional conducts that result in contrast with a substantial part of international law[44]. In particular, even if this provision does not encompass international law *in toto,* since not all international norms adapt to the specificities of outer space[45], its scope would include not only customary rules and fundamental principles contained in the UN Charter, such as the prohibition of the use of force and non-intervention[46], but also other branches of international law, including international

[42] ILC, *Preliminary report on international liability for injurious consequences arising out of acts not prohibited by international law, by Mr. Robert Q. Quentin-Baxter, Special Rapporteur,* A/CN.4/334 and Add.1 & Corr.1 and Add.2, Vol. II, p.253; L. Condorelli, 'La réparation des dommages catastrophiques causés par les activités spatiales', in Bibliothèque de la Faculté de Droit de l'Université Catholique de Louvain, *La réparation des dommages catastrophiques: Les risques technologiques majeurs en droit international et en droit communautaire* (Bruylant Bruxelles 1990), pp. 278-279.

[43] S. Hobe *at al., Cologne Commentary on Space Law: Outer Space Treaty,* Berliner Wissenschafts-Verlag, Vol. 1, 2009*,* p. 376.

[44] M. Lachs, *The Law of Outer Space – An Experience in Contemporary Law-Making*, Sijthoff, Leiden, 1972, p. 15

[45] *Idem,* p. 13.

[46] S. Hobe at al., *Cologne Commentary on Space Law: Outer Space Treaty,* p. 279.

humanitarian law and environmental law[47].

However, the regime of responsibility established by Article VI is strictly limited to national activities in outer space and therefore excludes the use of certain weapons, such as laser and cyber operations, that are activated from Earth with the aim of damaging space assets[48]. Therefore, States can be held responsible for such hostile activities only in cases where ASAT weapons are activated from space, even if controlled from Earth, and target other space objects. Nevertheless, the use of ASAT weapons, both kinetic and non-kinetic, could potentially lead to the establishment of the international responsibility of States acting in violation of the outer space legal framework considered in a broad sense, including the international norms recalled through Article III, thus demonstrating how the regime of responsibility established in Article VI could strongly contribute to deterring States from engaging in widespread hostile activities in outer space. In order to demonstrate this, in the following section, this paper will attempt to show how hostile activities in outer space could fulfil the objective element for the establishment of international responsibility, i.e. the violation of an international obligation, without going into questions of attribution, which constitute the subjective element of international responsibility.

4. *An (apparent) risky legal lag: an examination of the international regime regulating military activities in outer space*

Shortly after the launch of the first satellite into orbit, the Sputnik 1, the need for an international legal regime to limit the prerogatives of States in the exploration of this newly discovered domain became apparent. The novelty of the subject and the rapid development of space policies, particularly by the United States and the Soviet Union, led the 1960s to start negotiations under the auspices of the United Nations. The result was the Outer Space Treaty of 1967, which identified new principles of international law and adapted the existing ones to the new space landscape[49].

---

[47] A.C. Kiss, D. Shelton, *Guide to International Environmental Law*, Martinus Nijhoff, Leiden, 2007.

[48] L. Du, 'Cyber-attacks on Space Activities: Revisiting the Responsibility Regime of Article VI of the Outer Space Treaty', in *Space Policy,* 63(2023), 2023, p. 2.

[49] UNGA, *International Cooperation in the Peaceful Uses of Outer Space*, Res.1721 (XVI), 20 December 1961; *International Cooperation in the Peaceful Uses of Outer Space*, Res.1802 (XVII), 19 December 1962; *Declaration of Legal Principles Governing the*

Among these principles, the 'peaceful use of outer space' in the interest of mankind, which is stated in the Preamble, is of particular importance. Its inclusion as one of the fundamental guidelines for State activities in outer space proves that the risk of using weapons in outer space was already a pressing issue barely ten years after the beginning of the explorations in this new domain. However, these concerns did not lead to a commitment to total demilitarisation of outer space, as, under the pressure of the major space powers, it was interpreted only as a prohibition of aggressive uses of outer space, justifying the recourse to space weapons systems for self-defence[50]. This interpretation is also in line with the idea, reflected in Article III of the Outer Space Treaty, that orbits are not only a physical domain but also a legal one in which international law, in particular the Charter of the United Nations, applies, including the right of self-defence enshrined in Article 51 of the Charter of the United Nations.

Despite the absence of a commitment to total orbital disarmament, the high risk posed by the potential use, even in self-defence, of certain weapons, namely nuclear weapons and other weapons of mass destruction, led the States Parties to the Outer Space Treaty to agree on more stringent obligations, also in view of the need to guarantee the common interest of the international community in the exploration and use of outer space. It is therefore essential to examine the scope of legal restrictions on the militarisation of outer space in order to understand which weapon systems are clearly prohibited under the Outer Space Treaty and what restrictions on ASAT systems can be derived from the outer space legal framework in its entirety.

a. The scope and content of international legal restrictions to military activities in outer space

The principle of the 'peaceful use of outer space' is given concrete meaning in Article IV of the Outer Space Treaty, which establishes a dual legal regime for the demilitarisation of outer space[51]. In fact, while the Article identifies a regime of partial demilitarisation for the orbits, limited to certain weapons systems, it establishes more stringent obligations of full

Activities of States in the Exploration and Use of Outer Space, Res. 1962 (XVIII), 3 ILM 157, 13 December 1963.

[50] S. Hobe *at al., Cologne Commentary on Space Law: Outer Space Treaty*, pp. 159-160. This conclusion is also confirmed by the General Assembly: UNGA, *Question of general and complete disarmament*, Res. 1884 (XVIII), A/RES/18/1884, 16 October 1963.

[51] S. Courteix, 'Le traité de 1967 et son application en matière d'utilisation militaire de l'espace' in *Politique étrangère*, 1971, p. 260.

demilitarisation for the Moon and other celestial bodies.

More in detail, the first paragraph of Article IV prohibits the placement of 'any object carrying out nuclear weapons or any other kinds of weapons of mass destruction' in Earth's orbit, as well as their installation on celestial bodies and the stationing of weapons in outer space. This attempt of partial demilitarisation of the orbits should be read in conjunction with another international agreement, the Partial Test Ban Treaty of 1963, which prohibits any test or use of nuclear weapons in space. Even if Article IV of the Outer Space Treaty does not clearly prohibit the use and testing of mass destruction weapons systems, such a prohibition can be derived from a systematic interpretation of Article IV in the light of Article 1 of the Moscow Treaty, also taking into account that not restricting the use of these systems would in any case be contrary the peaceful use of the orbits. The different wording of the two provisions illustrates how the negotiations for the Outer Space Treaty led to weaken an earlier commitment, following the interest of some States to acquire or maintain control of orbits.

Be as it may, the prohibition of Article IV is limited to weapons of mass destruction[52]. Therefore, the deployment of any type of weapon that falls outside this category, including most of the ASAT systems described in the previous Section 2, is not prohibited under Article IV. The scope of this provision seemed even more limited, as it only prohibited the placement of weapons in Earth orbit. This wording led States such as the US and the Soviet Union to develop nuclear warhead delivery systems, namely Fractional Orbital Bombardment Systems (FOBS), which use orbital motion without completing an orbital rotation to hit targets by deorbiting before reaching them[53]. In particular, the United States and the Soviet Union, relying on an interpretation of the term "placement" as "fixed presence" in Earth's orbit[54], claimed that these systems did not fall under the prohibition of Article IV because the missiles did not complete an orbital rotation. Although this interpretation is not supported by the ordinary

[52] UNGA, *Prohibition of the development and manufacture of new types of weapons of mass destruction and new systems of such weapons,* A/RES/32/84/B, 1977. Weapons of mass destruction include "atomic explosive weapons, radioactive material weapons, lethal chemical and biological weapons, and any weapons developed in the future which might have characteristics comparable in destructive effect to those of the atomic bomb or other weapons mentioned above".

[53] B.B. Eisel, *The FOBS of War,* Air and Space Forces Magazine, 1 June 2005, [https://www.airandspaceforces.com/article/0605fobs/].

[54] O. Giarini, 'L'espace et le droit international' in *L'Europe et l'espace*, Lausanne, Centre de recherches européennes, 1968, p. 153 ff.

meaning of the provision[55], the attempt to circumvent the prohibition of Article IV shortly after its adoption shows how the ambiguous wording of this provision and its limited scope of application make it vulnerable to obsolescence as new weapons systems are developed.

Turning to the second paragraph of Article IV, as already noted, it establishes a regime of complete demilitarisation of the Moon and other celestial bodies, to be used only for peaceful purposes. In particular, it expressly prohibits "the establishment of military bases, installations and fortifications, the testing of weapons of any kind and the conduct of military manoeuvres". The restrictions to military activities are clearly more stringent for celestial bodies than for the space between them, since the provision prohibits any form of testing and use of any kind of weapon system, potentially including all the ASAT weapons described in the previous section. However, its reference to the principle of the "peaceful use of outer space" is interpreted by some as allowing the use of weapons systems in self-defence[56]: in this case, a regime of complete demilitarisation could not result even from Article IV, paragraph 2.

As shown above, the international demilitarisation obligations provided for in Article IV impose only limited restrictions on the military use of outer space. Thus, in order to understand the extent to which States are prohibited from engaging in military activities in space, it is essential to look at more general international obligations, in particular the prohibition of the use of force and the principle of non-intervention.

b. Going beyond the scope of Article IV: the prohibition of the use of force and the principle of non-intervention

Despite the quite limited scope of the obligations under Article IV, the Outer Space Treaty can still be read as incorporating a more comprehensive restriction of the military use of outer space. By recalling the prohibition of the use of force through the clause of Article III, also clearly re-stated in the Moon Agreement[57], the Treaty actually contains more stringent legal obligations with regard to the use of ASAT systems. The relevance of this prohibition, which does not exclude the placement of weapons in orbit for self-defence purposes, in the context of outer space is confirmed by regional instruments such as the 2014 International Code of Conduct for Outer Space Activities and the recently adopted Woomera Manual on the

[55] S. Hobe at al., *Cologne Commentary on Space Law: Outer Space Treaty*, p. 309.

[56] *Idem,* pp. 159-160.

[57] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 11 July 1984, 1363 UNTS 3, Article 3.

International Law of Military Space Activities and Operations[58]. However, given the absence of boundaries in outer space, it is essential to understand how the prohibition of the use of force 'against the territorial integrity or political independence of any State' can be applied in this context.

Firstly, this prohibition applies to 'any use of force, regardless the weapons employed'[59], since what counts is the simple physical effect of the application of the force. By focusing on the effects, it would allow to consider the intentional creation of space debris through the use of kinetic weapons in certain circumstances as a use of force prohibited by the UN Charter[60]. On the other hand, it is more problematic to apply this qualification to non-kinetic weapons, since their use would determine only temporary adverse effects on satellite systems, however impairing their military and civil functions, including positioning, missile interception and disaster relief. In this regard, inspiration could be drawn from the practice developed in the context of cyber operations, which considers under the prohibition on the use of force not only attacks that cause or are likely to cause physical damage to property, loss of life or injury to persons, but also those that determine a significant disruption of the functioning of critical infrastructures[61], severely disrupting the delivery of critical services. Therefore, if the use of non-kinetic weapons, such as laser and cyber operations against satellites are likely to determine the consequences just described, their use could be qualified as conduct contrary to the prohibition of the use of force.

With regard to non-kinetic attacks that fall below the threshold of the use of force, therefore not reaching a certain degree of severity, they could still be considered violations of the customary principle of non-intervention if they are carried out with the intent to coerce the target State to take or not take actions on sovereign matters in which each State is permitted to decide freely[62]. Indeed, in the context of cyber warfare, any non-armed conduct that causes or is intended to cause the loss of functionality of critical

---

[58] J. Beard, D. Stephens, *The Woomera Manual on the International Law of Military Space Operations,* OUP, 2024.

[59] ICJ, Legality of the Threat or Use of Nuclear Weapons, §39.

[60] E. Pobjie, *Outer Space, Military Uses of, §27.*

[61] M. Roscini, *Cyber Operations and the Use of Force in International Law,* OUP, 2014, Chapter 2. The Tallinn Manual on the International Law Applicable to Cyber Warfare defines cyber-attacks as those that cause damage consisting of a malfunction that requires the replacement of physical components: NATO Cooperative Cyber Defense Centre of Excellence, *Tallin Manual on the International Law Applicable to Cyber Warfare*, Rule 30, §10.

[62] ICJ, *Military and Paramilitary Activities in and against Nicaragua (Nicaragua v USA)*, Merits, Judgment, 27 June 1986, §205.

infrastructure with the disruption of essential services would be contrary to the principle of non-intervention if carried out with the intention of coercing another State to obtain the subordination of the exercise of its sovereign rights or any kind of advantage from the hostile conduct[63]. It is, therefore, clear that interference with data receivers of satellite systems by means of cyber-attacks may also be considered as conduct in violation of the principle of non-intervention, when it cannot be qualified as the use of force. Even if responsibility for conducts in contrast with this principle would arise with regard to a limited number of cyber-operations, since Article VI only applies cyber-attacks carried out with the help of space objects, the act of taking control of another satellite in order to jam the radio signals of another space object or to deorbit in order to hit it would be contrary to the principle of non-intervention[64]. By analogy, these considerations can be applied to hostile acts that disrupt the operation of satellites ensuring the functioning of essential services, such as telecommunications networks, which would violate the principle of non-interference.

In particular, with regard to electronic jamming, it should also be considered in light of the international telecommunications' legal regime. The Constitution of the International Telecommunication Union requires Member States to establish and operate all radio stations so as not to cause harmful interference to the radio services and communications of other States[65]. More specifically, the Radio Regulations clarify what is meant by harmful interference, defining it as a form of 'interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service'[66]. These provisions are therefore even more specific in prohibiting forms of electronic interference than the general principle of non-intervention, clearly impeding jamming activities that endangers communication satellites, unless they are used for hostile purposes, such as espionage, in which case jamming may be used for self-defence purposes or as a non-forcible countermeasure. However, there is a legal obstacle weakening the scope of these obligation: the Constitution recognises Member States freedom of action with regard to radio military

63 M. Roscini, 'Cyber Operations as a Use Of Force', in *Research Handbook of International Law and Cyber Space,* Edward Elger Publishing, 2015, p. 252.

64 L. Du, 'Cyber-attacks on Space Activities: Revisiting the Responsibility Regime of Article VI of the Outer Space Treaty', in *Space Policy,* 63(2023), 2023, p. 2.

65 Constitution of the International Telecommunication Union (ITU Constitution), 22 December 1992, Article 45.

66 ITU, *Radio Regulations,* 1st Edition, 2020, Article 1.169.

installations, establishing an exception to the general regime[67]. This undermines the possibility of concretely limiting the use of jamming systems, which by definition are electronic counterspace weapons falling into the category of military radiocommunications installations[68]. Therefore, the provisions of the ITU Constitution would doubtfully apply to electronic interference with satellite systems, leading to the applicability of the more general regime established under the principle of non-intervention.

Therefore, even though Article IV does not provide for a comprehensive system of limitations with regard to the demilitarisation of Earth's orbit, some assistance in holding States accountable for their harmful activities against other spacecraft can be found by taking a closer look at general international law. For the sake of completeness, other provisions of the Outer Space Treaty could also reinforce the restrictions on the use of weapons in orbit, in particular Article IX, which prohibits activities that interfere with the use and exploration of outer space by other States.

c. The prohibition of harmful interference in the use and exploration of outer space

Outer space is an environment with characteristics that are obviously different from those of the Earth's environment. In particular, for its natural characteristics, outer space could be easily subject to intentional or unintentional contamination, affecting the use and exploration of outer space by the entire community of States involved in space activities[69]. The existence of such a risk justifies the existence in the Outer Space Treaty of a provision requiring States Parties to conduct their activities in with due regard for the interests of other States Parties.

Article IX of the Outer Space Treaty imposes an obligation of due diligence, aimed at ensuring that the exercise of rights by States in outer space do not interfere with corresponding interests of other States Parties or threatens the security of space operations[70]. Outer space activities are, by their very nature, ultra-hazardous activities, not only because of the unintentional transport of living and other matters extraneous to the outer space environment, but also because of the rapid circulation of space objects at the orbital speed in this context. And if the obligation in Article

[67] ITU Constitution, Article 48.

[68] T. Harrison, *et al., Space Threat Assessment 2022,* Centre for Strategic and International Studies, April 2022, p. 4.

[69] D.E. Terrill Jr., *The Air Force Role in Developing International Space Law*, Maxwell AFB, AL: Air University Press, 1999, p. 59.

[70] S. Hobe at al., *Cologne Commentary on Space Law: Outer Space Treaty,* p. 568.

IX applies to unintended consequences of space exploration, it applies even more so to intentional damages to other space objects[71], such as the use of ASAT weapons, given that, according to the wording of Article IX, such damage results from '[national] activities in outer space'.

This due diligence obligation is reinforced by the second sentence of Article IX, which requires States Parties to avoid harmful contaminations of outer space. Even if the wording of the Article refers only to studies and exploration activities, a contextual reading of this obligation, in light of the prohibition of harmful interference[72] in outer space established in the first sentence of Article IX, allows for an extension of the obligation to avoid harmful contamination also to any use of outer space[73] . Harmful contamination is a broad concept, covering all forms of harmful interferences, both deliberate and unintentional[74], and should also be read in conjunction with the principles of international environmental law, applicable in the outer space context thanks to Article III of the Outer Space Treaty. In particular, the principle of prevention, which requires States to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction[75], including outer space[76], finds application in the legal framework under examination. More in detail, in the context of military activities, environmental obligation are enshrined in the First Additional Protocol to the Geneva Conventions, which prohibits the use of 'methods or means of warfare which are intended, or may be expected, to cause widespread, long-term and severe damage to the natural environment', and remains applicable in the event of hostilities in outer space[77]. However, in the absence of such hostilities, another international

[71] D.A. Cypser, 'International Law and Policy of Extraterrestrial Planetary Protection' in *Jurimetrics*, 33(2), 1993, p. 325.

[72] The notion of harmful interference in the context of Article IX has a sectoral meaning that must be distinguished from the notion of non-intervention examined in the previous paragraph.

[73] P. Achilleas, 'Planetary Protection-Legal Issues', in *Proceedings of the 46th Colloquium on the Law of Outer Space*, 2003, p. 215

[74] S. Hobe at al., Cologne Commentary on Space Law: Outer Space Treaty, p. 573.

[75] UNGA, *Declaration of the United Nations Conference on the Human Environment (Stockholm Declaration)*, A/CONF.48/14/Rev.1, 16 June 1972, Principle 21; *Rio Declaration on Environment and Development,* A/CONF.151/26, 12 August 1992, Principle 2.

[76] ICJ, *Legality of the Threat or Use of Nuclear Weapons, §29.*

[77] Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to

instrument, i.e. the Convention on the Prohibition of Military or any Hostile Use of Environmental Modification Techniques (ENMOD Convention), clearly prohibits any military or hostile use of environmental modification techniques, i.e. 'techniques for changing - through the deliberate manipulation of natural processes - the dynamics, composition or structure of the Earth', including outer space[78]. All these commitments contribute to the definition of a complex legal construct from which further restrictions on the use of ASAT systems can be derived.

This legal structure clearly covers the use of kinetic weapons, taking into account their impact on the space environment. In particular, the production of space debris from the high-speed impacts or explosions is a form of harmful contamination in contrast with Article IX[79]. Thus, the destruction of space objects would be prohibited under this legal framework if it could result in the release of debris, also taking into account the likelihood of damage to other space objects, as successive impacts could lead to the so-called Kessler effect, i.e. the multiplication of potentially untraceable debris threatening the functioning of satellites in crowded orbits[80]. This risk, even in the absence of a clear ban on the use of kinetic ASAT systems or any system likely to produce debris, has led States to issue unilateral declarations committing themselves to refrain from testing these weapons[81], also in line with the recent General Assembly intervention calling on States not to engage in such testing activities[82].

However, this conclusion is only tenable in cases where weapons interfere with the functions of satellite systems used solely for civil purposes, while it should be excluded when these systems are used to perform military or other hostile functions. In the latter case, any form of interference would be justified by recourse to circumstances precluding wrongfulness, in particular self-defence as applicable not only to responses to violations of the prohibition on the use of force, but to any wrongful act

the Protection of Victims of International Armed Conflicts, 1125 UNTS 3, 8 June 1977, Article 35.

78 Convention on the Prohibition of Military or any Hostile Use of Environmental Modification Techniques, 1108 UNTS 151, 10 December 1976, Articles 1-2.

79 D. Zannoni, 'Out of sight, out of mind? The proliferation of space debris and international law', in *Leiden Journal of International Law,* 35, 2022, p. 300-301.

80 D.J. Kessler, B.G. Cour-Palais, 'Collision Frequency of Artificial Satellites: The Creation of a Debris Belt' in *Journal of Geophysical Research*, 83(A6), 1978.

81 E. Pobjie, *Outer Space, Military Uses of*, §7.

82 UNGA, *Destructive Direct-Ascent Anti-Satellite Missile Testing*, UN Doc A/RES/77/41, 2022, §1.

under international law[83]. In addition, any hostile use of satellite weapons would also run contrary to the obligation of cooperation established in the first sentence of Article IX, therefore allowing the recourse to non-forcible countermeasures[84], including activities interfering with the normal functioning of satellite systems used to perform military functions.

The analysis in this paragraph has therefore attempted to show how hostile activity in outer space could potentially be considered also as a violation of the obligation under Article IX to have due regard for the interests of other Parties and to avoid any form of harmful interference. Thus, this violation is a wrongful act that allows States to be held responsible for the use of ASAT weapons in outer space as results clearly from the responsibility regime established under Articles VI and VII of the Outer Space Treaty previously examined.

5. *Conclusions*

The development of new and more sophisticated military technologies in outer space has proceeded at a pace that was hardly imaginable for the drafters of the Outer Space Treaty. In fact, new ASAT weapons are being programmed by the States more involved in the process of exploring and exploiting outer space, with the aim of taking control of a territory not subject to sovereign prerogatives. Therefore, the gap between law and technological development justifies the inadequacy of Article IV, whose objective was to establish clear obligations for the demilitarisation of orbits only limiting the deployment and testing of weapons of mass destruction in outer space.

However, as this paper has attempted to demonstrate, while the demilitarisation obligations are limited in scope, the drafters of the Outer Space Treaty have established other obligations that fill the gaps in the regulation of military activities in outer space. Indeed, States are obliged to comply with international rules, in particular the prohibition of the use of force and the principle of non-intervention, which would concretely limit the use of ASAT weapons if they could cause the destruction of property or the loss of functionality of critical infrastructure. The complexity of this

83 ILC, A*rticles on the responsibility of States for Internationally Wrongful Acts,* Supplement No. 10 (A/56/10), November 2001, Article 21.

84 *Ibid.,* Article 22, 49.

legal framework, which also prohibits interference with the interests of other States in the use and exploration of outer space in accordance with Article IX, helps to deter States from engaging in hostile activities in outer space that would result in a violation of the international norms by which they are bound.

This is reinforced by the presence in the Outer Space of a sectoral regime of responsibility, which clearly establishes a relationship between all the norms cited and the international responsibility of States conducting activities in outer space in contrast to them. This shows that the legal gaps often invoked by States to justify the potential use of military technologies in outer space can be filled by looking at the Outer Space Treaty in its complexity and at other international norms applicable to State activities in outer space. In light of the foregoing, a systematisation of these norms, as recently undertaken in the Woomera Manual, could be useful in order to have a clear picture of the scope of the prohibition of the military use of outer space, since the current state of international law is quite comprehensive but clearly needs to be integrated in order to avoid misinterpretation of existing norms and any risk of hostilities in outer space.

Valentina Barela

The Exploitation of Space Resources. A Prospective on Accords and New Governance

The extraction of space resources is definitely not a philanthropic theme. It's about profit oriented purposes and obviously leads to commercialization of those resources and a new market.

The premise before hypothesizing a new governance is the knowledge that Space resources can be very valuable for sustaining the ongoing operations in space or future exploration missions, addressed to establish human settlements for new activities like space mining and of course to support life on Earth.

Moon, asteroids, all celestial bodies are rich in water and precious minerals, such as platinum, nickel, gold and water. Their extraction and use are highly beneficial, in view of the enormous economic potential for humanity as the European Space Agency (ESA) has been highlighting numerous times on many occasions[1]. It is certain that the system of investment in the activity of exploitation of outer space resources has largely taken off: states have been developing a space exploration strategy to benefit from space resources and private entities are playing the main role[2].

These have brought about a great change and influence regarding the new governance in this sector, because it is not a secret for anyone that the existing American law about space activity has drawn strength from more than solicitations from these private companies.

The Moon is considered to be the greatest potential source of water ice in nature and, in particular, the land near the lunar south pole has been the target to detect and extract materials. NASA has confirmed deposits of ice

[1] PROSPECT (Package for Resource Observation, in-Situ analysis and Prospecting for Exploration Commercial exploitation and Transportation) is an European Space Agency project developed to explore and analyse lunar resources, particularly the water ice in the permanently shadowed craters at the Moon's South Pole.

[2] Several private business companies, such as Caterpillar, Moon express, Blue Origin, Deep Space Industries, have been investing in this sector, developing technologies for mining and collaborating with NASA to advance the necessity equipment and techniques for these extraterrestrial endeavours.

inside deep craters near the lunar south pole. The water, as you all know, can be converted into oxygen and hydrogen which, when combined, make a powerful rocket propellent. The opportunity to create in-situ propellent will foster space settlement activities and other industrial engagements, whose use goes beyond the utility of human colonies. The propellent, consequently, won't need to be supplied from Earth and transported throughout the solar system. It would be an enormous saving of economic energy and timing; and, indeed, the main purpose of space resource extraction activities so far is to produce consumables for space missions and settlements[3]. Consequently, the amount of mass that needs to be launched from Earth for missions could be greatly reduced, leading to substantial cost savings. In-situ Resource Utilization (ISRU) can be used as a laboratory from which we can learn the better use of these minerals contained in asteroids. Some asteroids are thought to contain a high abundance of water, as well as large amounts of organic carbon, phosphorus, and other key fertiliser ingredients[4]. Others are likely to contain various metals such as cobalt, nickel, gold, platinum and rhodium. The potential use of any such material includes space manufacturing, transport and terrestrial use of raw material, or on-site processing for further use[5].

There are also many concerns, with tough and legal implications, mainly environmental issues, that are growing around this theme: asteroid mining will inevitably create streams of debris that will contribute to increase the number of meteorites and exacerbate the movement of lunar dust. In addition, drilling and removing mass from asteroids will inevitably change their course. Mining operations could plausibly lead to an Earth impact emergency. Environmental issues would sky-rocket, perhaps, without the possibility of containing them.

Digging the lunar Pole is a threat to the ecosystem which should be protected under the aegis of the principle of province of mankind,

---

[3] The consumables include rocket propellants, reactants for energy production, life support gases, and materials for manufacturing spare parts or building planetary surface infrastructure.

[4] These asteroids are known as chondrite, stony and metallic-type asteroids, C-type asteroids.

[5] However, extracting resources in space for return to Earth is not financially viable so far but possible near in the future. R. Moenter, *The international space station: legal framework and current status*, in *J. Air Law Commer*, Vol. 64, 1999, p. 1033, *see* at http://scholar.smu.edu/jacl/vol64/iss4/3; K. Sacksteder and G. Sanders, *In situ Resource Utilization for Lunar and Mars Exploration*, in AIAA, 2007, in http://scholar.smu.edu/jalc/vol64/iss4/3.

a concept that certainly could define the boundaries and principles governing the commercialization of space resources. It is obviously the next phase after the exploitation of resources. The principle of province of mankind is a vague concept with the aim of celebrating the freedom of scientific investigation and to enhance the cooperation between states, ensuring benefits for all countries, without penalizing the ones who are economically weak.

This principle "theoretically" plays an important role in defining regulations for the extraction and exploitation of space resources. Its clear legal framework would clarify the possible entitlements of property to the resources extracted, even though a safe and controlled development of natural resources should be planned and managed.

In this occasion offered to me, I would like to tighten observations on the primordial governance that has been taken in the last decade. Before investigating the relevance of accords and the profile of new governance that is taking place in an unclear way, it is necessary to refer about the state of play today.

It is important to report forthwith that no international regulation is provided in the current existing regulatory framework, about exploitation of outer space resources. This is a very weak and controversial international framework, with many round tables at work[6]. Some proposals and municipal laws are enacted[7] and in process, and some apparently fruitful accords have been made and are being studied. I anticipate that the latter should attract our attention the most.

Many questions are left hanging in the balance: how is it possible to define a right to resources and within which boundaries and under which conditions exploitation missions can be started and carry on; and specifically which authorization procedure needs to be followed to lead, keep up and support these activities?

[6] The request for developing international law has been requested for a long time. *See* B. Cheng, *The Commercial Development of Space: The Need for New Treaties*, in *Journal Space Law,* Vol. 19, n. 1, 1991, p. 17; F. Francioni and F. Pocar, *Il regime di internazionalizzazione dello spazio*, Milano, 1999, p. 15; S. Hobe, *Adequacy of the Current Legal and regulatory Framework Relating to the Extraction and Appropriation of Natural Resources*, in *Outer Space Annals of Air and Space Law*, Vo. 32, 2007, p. 115; E.R. Finch, *Commercial Space Development*, in Millenium 2000, in *Journal of Space Law*, Vo. 27, 1999, p. 161.

[7] L. Rass-Masson, *Stratégies étatiques et lois nationales dans le droit international de l'espace*, in C. Bories, L. Rapp (eds), *L'espace extra-atmosphérique et le droit international*, Paris, 2021, *passim*. M. de Stuart, S. Henderson, M. Neumann, *Space resource activities and the evolution of international space law*, in *Acta Astronautica*, 2023, p. 155 ss.

Regarding the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (known as Outer Space Treaty 1967)[8], what we have heard thus far, is the main international law we need to look at: it refers to the use and the exploration of outer space, but no reference is made regarding exploitation or to the commercialization of resources[9].

The only indirect reference to exploitation is contained in Article I and in Article II, whose interpretation of the latter article is well-known as extremely controversial, to the extent that the exploitation is connected to the theme of appropriation. It states that "the Outer Space, including the Moon and Other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by other means".

Paying attention only to literal terms of Article II, the prohibition has been interpreted as applicable solely to States and not to private entities. Additionally, sovereignty has been deemed applicable only to claims of sovereignty and territory, specifically in terms of their exclusive use. In this sense, the resources extracted are not beaten from the "non-appropriation principle" as they are not direct consequences of sovereignty or specific national occupancy[10].

This article has caused a lot of arguments between scholars that I assume you are aware of[11]. However, it is possible to summarize that its reading, combined with Articles VI and I, leads to the assumption that exploration activities can also be carried out by non-governmental entities

[8] This Treaty has been completed by the "Rescue and Return Agreement", the "Liability Convention", the "Registration Convention and then the Moon Agreement" although its unsuccess. Regarding the historical and political context in which it was conceived *see* J.I. Gabrynowicz, *Space Law: Its Cold War Origins and Challenges in the Era of Globalization*, 37 Suffolk U. L. Rev., 2004, p. 1041.

[9] It is extremely relevant the fact that the OST entered into force during the peak of the Cold War within the context of the threat of deploying and using nuclear weapons in outer space. It helps to understand the strength and the weakness of this Treaty.

[10] T. Cheney, C. J. Newman, *Managing the Resources Revolution: Space Law in the New Space Age*, in *Frontiers of Space Risk: Natural Cosmic*, *Hazards § Societal Challenges*, 2018, pp. 245-269, Wilman, Richard J. eds.

[11] For a positive interpretation of the flexibility and generality of this article *see* A. Guyomarc'h, *Property on Space Resources: The search for a terminology, A focus on the moon and its mineral resources*, in *Journal of Law, Market & Innovation*, Vo. 2- Issue 2/2023, p. 80. *Contra*, A. Kerrest, *L'appropriation des resources minérales des corps célestes*, in Ph. Clerc and others (eds), *Le droit entre ciels et terres: mélanges en l'honneur du professeur Laurence Raillonì*, Paris, 2022.

without representing expression and actuation of national appropriation[12]. Nonetheless, any private space activities must be authorized by the states, and this weakens the rigid separation between public and private law. Article 2, however, outlines specifically the ban to subject outer space to "national appropriation by claim of sovereignty", thus it doesn't exclude national appropriation as a form of territorial sovereignty. On the other hand, Article 1 states that all countries are entitled to explore and "use" outer space with very undefined parameters; the use presupposes exploitation and that the latter can be conceived as an activity "for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development" and shall be considered as "the Province of all Mankind". Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all states without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies. Scientific investigation in outer space, including the Moon and other celestial bodies, shall be unrestricted, and states shall encourage and support international co-operation in such endeavours.

Scholars have compared space mining to deep seabed mining regulation following the interpretation path of United National Conference on the Sea (UNICLOS) with specific reference to the concept of "Common Heritage of Mankind" considering the outer space as a *res communis omnium*, whereby States are entitled to use resources extracted, provided their activities do not involve any claim over outer space or does not prevent other countries from carrying out the same activities[13]. The differential element between the principle of the Province of all Mankind and that of the Common Heritage

[12] Article VI of the Outer Space Treaty addresses international responsibility, specifying that "the activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty" and that States Party shall bear international responsibility for national space activities whether carried out by governmental or non-governmental entities. *See* B. Cheng, *International Responsibility and Liability for Launch Activities*, in *Annals of Air and Space Law* (XX), 1995, p. 297.
Contra. Some scholars consider the letter of this Article constrain to private person as well. This is the interpretation of F. Tronchetti, *The Exploitation of Natural Resources of the Moon and Other Celestial Bodies: A Proposal for a Legal Regime*, 2009, Brill- Leiden, p. 9 ss.

[13] *See* F. Tronchetti, *The Non-Appropriation Principle as a Structural Norm of International Law: A New Way of Interpreting Art. II of the Outer Space Treaty*, in *Air & Space Law*, 2008, p. 301; M. Svec, *Outer Space an Area Recognized as Res Communis Omnium: Limits of National Space Mining Law*, in *Space Policy 60*, 2022, in *ScienceDirect*.

of Mankind is given precisely by the fact that the former does not force the sharing of the benefits that derive from the exploitation of resources in space[14]. The principle of "Common Heritage of Mankind", formulated for international maritime law, particularly for deep bed mining activities, in the Convention on High Seas and in the Antarctic Treaty, however, is not effective in space law through an international management regime[15], although this was the plan of the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, dated 1979 and better known as the Moon Agreement.

The principle of "Common Heritage of Mankind" is pivotal in the Moon Agreement, where Art. XI states that "the Moon and its natural resources are the Common Heritage of Mankind". Furthermore, Article 4 relates this principle to the exploration experience establishing: "The exploration and use of the Moon shall be the province of all mankind and shall be carried out for the benefit and the interests of all countries irrespective of their degree of economic or scientific development". This Treaty is regarded as a failure due to the lack of ratification involved in space activities, attributable to the international and controlled regime for which it meant to lay the foundations, specifically for the equitable sharing benefits that should be aimed by all states parties in the advantages derived from those resources[16]. Obligations referring to the disclosure of all discoveries and to the sharing of benefits between them have discouraged all the states from ratifying agreement. Therefore, there has been resistance by nations with advanced space programs, which prefer more flexible regulations based on bilateral agreements, such as the Artemis Accords promoted by the United States, on which I would like to focus.

Regardless of the adversities manifested towards the Moon Agreement, it can be affirmed that the analogy with fishing in the high seas, the latter

[14] The differences between "province of all mankind" and the "Common Heritage of Mankind" are well outlined by M. Schwanebeck, *Fifty Years of Space Law: Basic Decisiond and Future Challenges*, Hastings International and Comparative Law Review, V. 41, n. 3, 2018, pp. 248-249. The Author traces the historical evolution of the concept of Common Heritage of Mankind. *See*, D. Fisher, *The Concept of the common heritage of mankind*, Research *Handbook on Fundamental Concepts of Environmental Law Cheltenham*, UK: Edward Elgar Publishing, 2026, pp. 306- 334.

[15] M. Venkateshwara Subramaniam, *The Common Heritage of Mankind: Implications for the Legal Status of Property Rights on the Moon and Celestial Bodies*, in *Proceedings of the Thirty-Ninth Colloquium on the Law of Outer Space* (October 7-11, 1996, Beijing, China), *American Institute of Aeronautics and Astronautics*, Reston, 1997, p. 31.

[16] *See*, F. G. Von Der Dunk, *Private Property Rights and the Public Interest in Exploration of Outer Space*, in *Biol. Theory 13*, 2018, pp. 142-151.

recognized as "Common Heritage of Mankind", is questionable because the Convention on the High Seas as well as the Antarctic Treaty defined limitations that can be presumably considered in outer space, bearing in mind the timing they were enacted. It is undeniable that life in outer space in terms of exploitation or even tourism space wasn't predictable, at least in this short number of years.

After this brief premise, I would like to discuss the current attempts to establish an international regime and regulation that all the states officially and non-officially are providing, internally and with different grades of international sharing. What is certainly the starting point is the observation that, although some international scholars do not want to admit the legality of commercialization because of Art. II OST, we are here to discuss it because some nations were not intimidated by this article. On the contrary, they wanted to resist it, interpreting it in their favour, masking therefore a formal adaptation to the law. Thus, there have been various national laws on exploitation and the US was the trailblazer in 2015[17], Luxemburg, United Arab Emirates, and Japan, and Slovenia followed suit.

Moreover, the solicitation by private investors was decisive for enacting the laws on space resources and is still pivotal to analyse what they have been doing today, especially in the search of definition of new governance. Private investors have determined a new balance inside of a conventional hierarchy of regulatory sources and testify the new balance among concealed forces that displace the traditional public authority or even better they embody the core of these forces.

The US law, the Commercial Space Launch Competitiveness Act of 2015, was boosted by two American companies (Planetary Resources and Deep Space Industries) to develop their space missions to harvest water and minerals; they lifted the inaction of this law to exhort US citizens to invest in space missions.

However, it is remarkable that the representative role of the nation is not supplanted or replaced by any private entities.

The intention of the US law, along with other subsequent municipal laws, is to legalize the exploitation of space resources setting a few rules. However, legislators seem to overlook the larger issue that this goal necessitates a partnership that all nations are eager to participate in.

In this field, it's clear the bigger you are, the more you represent, the more power you have. It is extremely important that all the municipal

[17] P.J. Blount, C. J. Robinson, *One Small Step: The impact of the U.S. Commercial Space Launch Competitiveness Act 2015 on the exploitation of resources in outer space*, in *North Carolina Journal of Law § Technology*, 2016, Vol. 18, p.160.

laws and the bilateral accords, the latter being very important, agree to identify states as the representative actors in international platforms and discussions on outer space resources in accordance with what has been established by international law. The nations are still the main interlocuters in international dialogue, even though the economic power and efficiency of private investors have rocketed and have altered the boundaries between public and private law, as we have already heard. The relation between private and public power is resolved internally, therefore it is necessary to recognize the leadership of many private entities, politically and economically.

However, the strength of any international accords is up to nations, in their undisputed representative role of national identity that ask them to certify and supervise all space programmes. It is extremely important that all the municipal laws and bilateral accords agree to identify states as representative actors in international platforms and discussions on outer space resources in accordance with what was established by international law. Although the granitic recognition of the representative role of the state in international role seems to be mandatory, it should not be taken for granted, especially in this revolutionary era.

Article VI of the Outer Space Treaty, indeed, boosts this ruling, establishing that "States Parties to the Treaty bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities, are carried out by governmental agencies, or by non-governmental entities". This responsibility and control are strictly tied to a register system. In fact, all municipal laws are focused on offering a registration system able to identify and control and supervise all current and future activities. States must oversee all programs and missions undertaken, either by public entities or private enterprises, and they must comply with some prerequisites for securing a licence.

This is the first stage to reach an international regime: space economy required a centralized system able to track osmotically all the players in action. And this international regime cannot be achieved through municipal laws, even though these laws mainly are a way to gather international political consensus that is the basis for international legal consensus[18]. That's why we must not underestimate the value of these

[18] The theory of consensus-based international law which can be held under certain well-defined conditions needs to take into account the fact that "international legal obligations can be derived from a widespread agreement among the members of the international community, even in the absence of state practice and written consent". It is what has been stated by B. Cronin, *Purging the Odious Scourge of Atrocities: The Limit of*

national laws, nevertheless a projection of some hypotheses of system, settlement and management of space resources can, indeed, be achieved through bilateral accords that are in progress.

Bilateral accords represent a second stage of this path which aspires to an international regime and represents a design of a new governance which relies upon different actors working together in non-hierarchical networks. They manifest themselves in different forms and from different sources.

In this regard, it is therefore appropriate to mention first the Artemis Accords, dated 2020[19], led by NASA, and the subsequent executive order, signed by Trump on "Encouraging International Support for the Recovery and Use of Space Resources"[20]. Both seem to have the aim of giving international validation to municipal laws. These are a series of bilateral agreements initiated by the United States with the intent of facilitating international cooperation in space exploration under the Artemis Program, which seeks to return humans to the Moon by the end of 2024. They have been signed by multiple countries, including some that are not parties to the Moon Agreement and mainly with those who have taken legislative initiatives about outer space exploitation. The hidden intent, indeed, appears more precisely to provide international recognition to domestic laws; in fact, the exploitation and commercialization of outer space resources, in the main municipal rules, are legally recognised and considered as granted. The Accords emphasize principles such as peaceful exploration, transparency, interoperability, and the sustainable use of space resources.

The core of this program is a new mission to the Moon to be followed by missions to Mars and beyond, considering it as a platform or a space base from which to launch missions to more distant destinations. Its goal is to supply strong support for the US position, shared with other legislative

consent, in *International Law*, Oxford, 2023, p. 37. The Author highlights the relevance of corpus of soft law as outcome pattern of resolutions passed by decision-making bodies within intergovernmental organizations. This analysis starts from arguing about qualitative changes in the form of global governance, specifically about the practice of international developed consensus about the control of "excessive internal state violence" (violent prosecution of defined group).

19 R. Deplano, *The Artemis Accords: Evolution or Revolution in International Space Law?*, in *International and Comparative Law Q.*, 70(3) 2021, p. 800.

20 Executive order declares: "Americans should have the right to engage in commercial exploration, recovery, and use of resources in outer space, consistent with applicable law. Outer space is a legally and physically unique domain of human activity, and the United States does not view it as a global common. Accordingly, it shall be the policy of the United States to encourage international support for the public and private recovery and use of resources in outer space, consistent with applicable law".

active states, that the OST does not preclude "a sort of" property rights over extracted resources.

The US, on the other hand, has been the first nation to enact the law that promoted the exploration and collection of materials extracted (from space or, specifically, asteroids) for commercial purposes by US citizens, granting them the right to detain, possess, transport, and sell what they obtained "in accordance with applicable laws, including international obligations of the United States". The reference is not to the right of property but to all its entitlements.

Other nations, Japan[21], the United Arab Emirates[22], Luxemburg[23], subsequently adopted national laws with similar contents[24], using U.S. law as a reference model. Certainly, in this regard, the Luxembourg law has been the most brazen about ownership theme. In fact, in Article 1 it

[21] *See*, *Japan: Space Resources Act Enacted*, LIBR. CONG., https://perma.cc/WS9J-QZKS. S. Kpzuka, *National Space Law and Licensing of Commercial Space Activities in Japan*, LJ Smith, I. Baumann, and S. Wintermuth (eds), Routledge Handbook of Commercial Space Law (Routledge 2024).

[22] *See*, *Federal Law* No. 12 *on the Regulation of the Space Sector*, art. 4 (Dec. 19, 2019) (U.A.E.) https://perma.cc/L32M-WKCT. This law further regulates the Emirates Space Agency. The law concerns the consideration of various activities in space, from the launch of vehicles into space to the extraction and transportation of resources.

[23] *See Loi du 20 juillet 2017 sur l'exploration et l'utilisation des ressources de l'espac*e (Law of July 20th, 2017, On the Exploration and Use of Space Resources). Luxemburg is the first European Country to estabilsh a clear regulation of ownership rights of minerals, water and other resources extracted from outer space-atmospheric, particularly from asteroids. This includes passing a law that governs their exploration and utilization, thereby granting private entities a range of rights. According to the provision of art.1 the space resources in question are susceptible to appropriation in compliance with the principles which inspire the entire *corpus spatialis*, provided that the authorized operator carries out the activities referred to in the same art. 1 "in accordance with the conditions of the authorization and the international obligations of Luxembourg" (art.2). Additionally, it has created Luxembourg Space Agency. Luxembourg aims to attract numerous major companies by offering a favourable tax plan and providing the opportunity for all companies headquartered in Luxembourg to obtain a license, provided the applicant holds at least 10% of the capital. Very important is the fact that the law expressly establishes that resources can be subject to appropriation, and no explicit or implicit reference is made to Article 2 of the Outer Space Treaty (OST). In contrast to the United States, where it is mentioned that activities cannot be subject to claims of ownership or sovereignty, but not mention the word "appropriation". The United Arab Emirates and Japan, on the other hand, remain generic, stating their interest in complying with international law.

[24] *See* M. M. DePagter, *Who Dares, Wins: How Property Rights in Space Could be Dictated by the Countries Willing to Make the First Move*, in *CJIL Online* 1.2, 2022, p. 116.

states, in a concise and clear manner, that "space resources are capable of being owned".

Going back to the Artemis Accords, they are a set of nonbinding multilateral and bilateral agreements, consisting of 13 provisions, which were established by the US in collaboration with Australia, Canada, Italy, Japan, Luxemburg, United Arab Emirates and the United Kingdom. The main players that have provided internal law on outer space and aspire to some sort of international recognition[25].

Furthermore, Artemis Accords are extremely reliant upon engagement with commercial partners. As it has been affirmed for the municipal laws, the actual prospective of Accords and the shape of new governance are characterized by hidden private powers and many initiatives from the bottom, in terms of hierarchy of source of law. They are not legally binding instruments, but they represent a "political understanding", a slow building of a foundation, of a shared consensus on some basic rules, in order to proceed to more detailed regulations. This prospective is not shared with some scholars, who consider these unilateral declarations, as well as the municipal laws, as a risk and threat to international consensus[26].

It should be recognized that the reference to the due compliance with international law, and specifically to the Art. II of OST, whereby the signatories assert that the extraction of space resources does not inherently constitute national appropriation under Article II, is a way to assign a specific and clear interpretation to this article[27]. That is to say: any extraction and possession and commercialization does not affect the

[25] *See* E.A. Taichman, *The Artemis Accords: Employing Space Diplomacy to De-Escalate a National Security Threat and Promote Space Commercialization*, in *American University National Security Law Brief, Vol. 11*, N.2. 2021, pp. 112-113. The signatory states are today forty-two: Angola, Argentina, Australia, Bahrain, Belgium, Brazil, Bulgaria, Canada, Colombia, Czech Republic, Ecuador, France, Germany, Greece, Iceland, India, Israel, Italy, Japan, Lithuania, Luxembourg, Mexico, the Netherlands, New Zealand, Nigeria, Peru, Poland, the Republic of Korea, Romania, Rwanda, Saudi Arabia, Singapore, Slovenia, Slovakia, Spain, Sweden, Switzerland, Ukraine, the United Arab Emirates, the United Kingdom, the United States, and Uruguay – in affirming the Accords' principles for sustainable civil space activity.

[26] This is the opinion of S. Mosteshar, *Commentary. Artemis: The discordant accords*, in *Journal of Space Law*, Vol. 42.2, 2020, p. 591. The Author defines the Accords as "a retrograde step undermining the Outer Space Treaty" (…) and it "can only breed international discord among international community" raising concerns because meant as a form of pre-announcement of a militarization of space.

[27] The Accords declare "that the extraction of space resources does not inherently constitute national appropriation under Article II of the Outer Space Treaty".

prohibition on appropriation and assertion of state sovereignty in any way, enshrined in the Article II.

We must consider that France, Germany, India, Russia didn't agree with it, and China is excluded from the Artemis Accords primarily due to geopolitical tensions and legislative restrictions imposed by the United States[28]. Besides, China has rapidly developed its space capabilities, including programs for the Tiangong space station, robotic missions to the Moon and Mars, and plans for future manned missions. Hence, China is seen as a direct competitor to the United States in space exploration: this factor further reduces the possibilities for cooperation under the framework of the Artemis Accords. The absence of these states in the Accords, however, does not hinder the advancement of the principles being promoted, provided that other States, such as China, reach other forms of agreements with similar content.

This is because the fact that heterogeneous and multi-level advancement creates an underlying desired consensus on the legitimacy of a "permissive interpretation" of Article II. It represents a pre-emptive shared starting point from where moves towards a creation of international systems of authorisations and operational rules can begin[29].

Evidence is offered by the Memorandum of understanding, signed by the Russian Space Agency (ROSCOMOS) and the China National Space Administration (CNSA) to jointly construct the International Lunar Research Station (ILRS).

This project, which runs parallel to the Artemis, strives to develop a research station on the lunar surface and/or in lunar orbit. This plan was announced in 2021 formally inviting other states and international organizations to become involved, and to take part in the establishment of a permanently inhabited base on the Moon (ILRS) for performing experiments and studies on the lunar surface. Its purposes encompass

[28] Since 2011, the United States Congress has imposed the so-called "Wolf Amendment," which prohibits NASA and the White House Office of Science and Technology Policy from engaging in bilateral cooperation with the Chinese government or Chinese-affiliated entities unless such cooperation is explicitly approved by Congress. This legislation was adopted for reasons of national security and to prevent the transfer of sensitive technology.

[29] In the meantime, there is a bill that aims to reorganize and simplify the authorization procedures for private space activities, albeit in an individualistic spirit. It is the American Space Commerce Free Enterprise Act (2017), that can be considered as a bipartisan bill that streamlines the regulatory process, limits government intrusion, promotes American innovation and investment, protects national security, at least formally satisfying Outer Space Treaty obligations.

collaboration in fields like lunar observation, scientific investigations, in-situ resource utilization, extraction of lunar resources, and human exploration of the Moon.

"Openness" and "neutrality" seem to be the strength of the ILRS but at the same time the weakness for the purpose of execution, that is, the adoption of operational measures. This is the main difference with the Artemis Accords that do not provide openness regarding the determination of rules but only regarding the signing of agreements, which are already defined. Hence, it is important to draw attention to the fact that, in contrast to the Artemis Accords, the ILRS are open to a cooperation about the future of the determination of rules.

Both nations (Russia and China) intend to pool their resources and expertise to create advanced technologies for space exploration and research[30]. Their relationship and space cooperation has mutated into a comprehensive strategic partnership, against US dominance, with a constant quest for program sharing[31] Putting aside political aspects, which of course are important, this evolution also reveals China's drive to increase its soft power (through attraction rather than coercion) while developing its hard power. This seems to be the mantra of this *modus operandi* in exploration and exploitation space era.

The two extensive and enduring lunar cooperative initiatives are venturing into uncharted territory, shaping a fresh blend of cooperation and competition, thus amplifying, and entangling the relationships among space-faring nations[32]. The discourse surrounding the configuration of

[30] The agreement involves the exchange of technologies, scientific knowledge and mission data.

[31] By evolving from a stance of national self-reliance to initiating multilateral space cooperation platforms, China provides a clear example of the dynamics between techno-nationalism and external constraints. *See* Xiaodan Wu, *The International Lunar Research Station: China's New Era of Space Cooperation and Its New Role*, in *The Space Legal Order, Space Policy*, 2023, p. 65. The Author outlines the metamorphosis of China's approach to space cooperation, considering its undeveloped pointing start. Furthermore, he claims that China's distinctive combination of being both a space-faring nation and a developing country has the potential to help address the challenges surrounding the democratization and decentralization of international space law.

[32] This cooperation translates into the phenomenon of ridesharing in the space sector, which means generally the launch of a secondary payload as part of someone else's mission, usually involving a reduced-price tag and less control over some other mission elements. The market interest for ridesharing has increased notably over the past decade. Some reasons are the development and availability of more private launch vehicles, the establishment of large satellite constellations requiring more launches overall and the ability to achieve certain mission objectives with smaller and modular spacecraft.

the ILRS and the implementation of Artemis Accords will enhance the organizational dynamics and the interplay between competition and cooperation, laying the foundations for an arrangement and order of space rules. Considering that the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries, it is needed to mitigate the risk of marginalization of economically and scientifically underdeveloped countries but regrettably it doesn't seem to be the main goal. Furthermore, the obligation of sharing scientific knowledge can be insidious in practice due to the risk of parasitic competition, which is a separate concern.

Once the shared opportunity for resource exploitation has been recognized, it is appropriate to assess what is being planned to offer some sort of regulation, with a view to conflict prevention.

For instance, the control of the missions through an authorization system and the continuing supervision represents the common thread in all national laws and working group initiatives.

Every hypothesis of regulation seems to start from a clarification of "administrative aspects" linked with licences and authorizations and any entitlement on the resources seems to come after. In fact, mostly all relevant initiatives and platforms that have emerged, dedicate many rules to authorizing procedure, listing prerequisites for securing a licence, which involve demonstrating the capacity to carry out their proposed plans. About this issue, and among all the initiatives, the remarkable one has been taken up by The Hague International Outer Space Resource Governance working Group, that delivered the Building Blocks comparatively recently (2019).

In US, for example, Space Exploration Technologies Corp (Space X), which develops launch vehicles for a various purpose as well as the Starlink communications satellite mega-constellations, has established a dedicated Small sat Rideshare Program in the context of its launch activities. Moreover, in 2022 the National Aeronautics and Space Administration (NASA) "has selected 13 companies to provide launch services for the agency's Venture-Class Acquisition of Dedicated and Rideshare (…), providing new opportunities for science and technology payloads and fostering a growing U.S. commercial launch market".

The European Space Agency (ESA) also sees value in partaking in the satellite ridesharing. From an economic perspective, ridesharing benefits states and others not only by generating additional income, but there is the additional benefit of making satellite launch more affordable to smaller actors with less funds, potentially contributing to economic development at large. Naturally, there are many legal aspects to consider when engaging in ridesharing as contracts may involve entities and jurisdiction, but everything needs to be defined.

This group, although it is not officially affiliated with the United Nations, operates with the goal of influencing policy and shaping international frameworks through its recommendations. It is another form of settlement expression for a new governance. It does not have formal authority to create binding agreements, but its specific focus on space resource utilization offers specialized insights and guidelines on space resources. The group includes a wide range of stakeholders, including legal experts, industry representatives, and academics, which allows for diverse input into the policy-making process[33].

Despite the pivotal aspect of authorization, relying solely on administrative regulation for private space activities is insufficient for effecting preventing harm and conflicts. Whatever rules will be taken, it needs to face the issue regarding the nature of the entitlement of space resources, that should be dealt, in parallel, with the issue of "province of mankind", which is the root of legal nature of space.

For this reason, it is important to highlight the provision n. 7 of the Building Block which identifies and analyses the priority rights that are not exclusivity rights. It embraces both prospecting and exploration rights, "the right search for" and "the right to recover" space resources for a minimum period and for a maximum area, upon registration in an international registry and provide for the international recognition of such priority rights[34].

The attribution, duration, and the area of the priority right should be determined on the basis of the specific circumstances of a proposed space resource activity, with the aim of taking into account a certain degree of protection of rights.

It seems an invitation to alter the traditional legal nature of the right to goods and it would lead us to presume and accept a new attribution of spaces natural resource[35]; for this reason and in this sense, the framework

[33] The Working Group which delivered this important work was composed of members and observers from government, industry, universities, and research canters. So, the view and prospective is quite wide. It addresses all the matters, from the general to the particular. The starting point is the need of the objective and principles of an international legal framework. From the definitions of key terms, the focus goes on substantive matters, such as jurisdiction over space resource activities, access to and utilization of space resources, sharing of benefits arising out of the utilization of space resources, and then the exchange of information under the international legal framework. The issues of liability, of monitoring and compliance are deal with.

[34] See, G. Wang, X Huang, *The establishment of the priority right in space resources activities*, in *Advances in Space Research*, 2023, p. 918, in *sciencedirect.com*;

[35] *See*, for instance, the proposal of E. Beauvois and G. Thirion about the Partial Ownership for Outer Space Resources, in *Astronautics Science and Technology*, 2020, p. 29.

of outer space is not satisfactory either as a "res nullius" or as a "res commune"[36].

However, conceiving a more flexible vision of the right to goods does not mean to offer less rigor but variable parameters, albeit previously identified.

The governance that lies ahead for the new space economy must therefore consider many factors, which do not manifest themselves in traditional ways. And although bilateral agreements, because they are non-binding, seem to have little relevance, they have a factual and formal decisive value as a construction of common consensus.

In this scenario under construction, it would be sensible to highlight the capabilities and the potential of Space agencies to represent the private and public interests as for instance NASA, JAXA, European Space Agency are doing, in addition to China National Space Administration and Russian Space Agency. They have a structure suitable to embrace the difficulty of multilevel governance coveted.

In these terms, the research work is even more challenging, and hopefully helpful for building a new governance.

[36] G. Wang, X Huang, cit., p. 922.

Simone Benvenuti

Fundamental Rights and Outer Space

Summary: 1. Introduction – 2. The changing context: causes, purposes, actors and legal tools of the space race – 3. Space technologies as a threat on fundamental rights – 4. Space technologies and the promotion of fundamental rights – 5. Conclusive remarks: legal and contextual weaknesses of fundamental rights in space law.

1. *Introduction*

I was asked by the organizers of the Conference to reflect upon the interplay between space law and fundamental rights. To start with, I must confess that, as a comparative constitutional lawyer, I struggled with the need to set a clear perspective for my presentation. I always considered – and I think this view is largely shared – that space law is first and foremost a domain of international law and of international lawyers. More recently, also (comparative) private law and (comparative) private lawyers stepped in, following the increasing privatization of space activities, including the centrality acquired in some countries by private actors in activities once operated by public agencies and the (potential) commercial exploration and exploitation in areas such as space mining, telecommunications or space tourism (private commercial sub-orbital flights).

I considered in turn space law only indirectly and selectively touching upon the constitutional dimension. In this respect, the statement in article II of the Outer Space Treaty – according to which "[O]uter space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty" – made clear the non-State, and thus non-constitutional nature, at least in a strict, traditional sense, of the principles of space law and of the practical issues related to outer space.

In addition to this, as scholars have pointed out[1], fundamental (human)

[1] D. Ireland-Piper, S. Freeland, Space Law, *Human Rights and Corporate Accountability*, in *UCLA Journal of International Law and Foreign Affairs*, 2022, 1, p. 3; S. Freeland – R.

rights and space law have run parallel for many decades, the humankind-oriented approach expounded in the "founding" Space Treaties being as the only common, but indeed very broad denominator. The reason lies in the fact that, in the very beginnings of the space race, the state of the relevant technologies and the purposes of their potential applications (limited to warfare or to scientific discoveries at best) showed a limited direct link to ordinary human activities and to the lives of people on earth outside exceptional circumstances, like war. But even today, a thorough analysis of the existing literature still witnesses a split between space law and fundamental rights. A simple search on library databases proves the limited number of works delving into this dimension[2].

Nonetheless, a link between space law and the constitutional dimension exists, not just because principles of non-appropriation and principled exclusion of sovereignty claims do not entail *per se* the lack of any State-jurisdiction in outer space – with all consequences deriving from that in terms of potential application of constitutional principles and rights in, for instance, future space "colonies"[3], especially so in such a fragmented regulatory landscape. This link exists – and such is the perspective of this presentation – in relation to the (potential) negative or positive impact of space-related activities on fundamental rights, either individual or collective, some of them also being internationally protected human rights.

To understand how space-related activities and fundamental rights intertwine and how such intertwinement has become so intense today, it is important to first frame it in the historical context (Section 2). The historical context is indeed today very different compared to fifty or even thirty years ago. Space technologies have become increasingly pervasive over time, thanks also to the flexibility resulting from the privatization of the space sector; furthermore, a comprehensive outlook of the place of domestic legislation and its complex interaction with international binding and soft law instruments is today essential to understand the space legal field. I then look upon what can be termed as the "negative" side of the relationship between space activities and fundamental rights, i.e. the threats of space activities on fundamental rights and how such threats are taken into account from a legal perspective (Section 3). After that, I

S. Jakhu, *The Intersection between Space Law and International Human Rights Law*, in R. S. Jakhu, P. S. Dempsey (eds.), *Routledge Handbook of Space Law*, Routledge, 2017, p. 226.

[2] Among the authors who devoted some interest to the interrelation between Space Law and Human Rights are Irmgard Marboe, Danielle Ireland-Piper, Steven Freeland, Ram S. Jakhu and Jonathan Lim.

[3] C. S. Cockell, *The Institutions of Extraterrestrial Liberty*, Oxford University Press, 2023.

stress the importance of the "positive" side of such relationship, based on the observation that the enjoyment and actual fulfilment of fundamental rights can greatly benefit from advancement in space technologies (Section 4). I conclude, by observing that fundamental rights in space law suffer a double weakness that is legal-formal and contextual. Since space law is still an unstructured field, subject to strong extra-legal pushes, we should pay attention to the latter especially, recognizing the strict relationship between fundamental rights and the principles of humanity and social development.

2. *The changing context: causes, purposes, actors and legal tools of the space race*

If we are to look at what has changed, we should consider three levels at least: one relating to the causes and purposes of the "space race", the second one relating to the actors involved in it, and the latter one concerning the legal framework constituting the field of space law more broadly.

First, as to causes and purposes of the space race, one should not underestimate that in few decades, technologies greatly developed, and their potential applications too. While at its inception space exploration entailed essentially military use or scientific exploration[4], a variety of aims can now be achieved through space technologies. As it has been put it, "space has started to host all sorts of human activities, or better, play a fundamental role in them: military, scientific, administrative, crime fighting and anti-terrorism, commercial, and humanitarian"[5].

Examples of such applications beyond improving research and military/national security uses are detection of environmental changes, management of natural disasters, weather forecasting, improving communication systems, helping navigation and positioning more generally, transportation of goods and individuals for different purposes, energy production, etc. It is easy to understand how the multiplication of space-related activities having direct and concrete effects on individuals (and groups of individuals) living on Earth, enjoying fundamental rights in their respective jurisdictions, poses problems of regulation and protection of those very same rights.

Second, actors changed too. While space law exploration used to be just a matter for States, and State spacefaring superpowers in the first

[4] F. von der Dunk, *International Space Law*, in F. von der Dunk – F. Tronchetti, *Handbook of Space Law*, Edward Elgar, 2015, p. 48.

[5] F. von der Dunk, *International Space Law*, cit., p. 125.

place, and the relevant State agencies, the landscape is today much more fragmented. Not only more States are involved in State exploration, including regional organizations themselves gathering a number of States coordinating national space programmes of the countries involved[6]. As a very rough indicator of this trend, one might think that of the more than seventy existing Government space agencies around the world, less than half was established before the 1990s, while more than half was established in the last 25 years[7]. Sure enough, only few of them have launching capabilities, their role being mostly that of regulating the multiple facets of the space field and promoting space policies, still this witnesses the growing importance of the relevant activities.

In addition to this expansion that is directly related to the accessibility and versatility of space technologies for civil uses, fragmentation of the space field derives from the increasing weight of the private sector connected to the epochal shift towards the space economy. Private business entered the space race and is now an important component in it, at least in some jurisdictions. Increasing activities of private actors is further accentuated by the process of privatization of once public entities especially in the Western world such as INTELSAT, INMARSAT or EUTELSAT[8], resulting too from the multiplication of space technological applications. NASA itself nowadays relies on Commercial Resupply Services by private operators and recently offered flight opportunities for commercial providers to utilize the International Space Station (ISS) as a destination for private astronaut missions, as a strategy to drive down transportation costs for the future and enable a vibrant low Earth orbit economy[9]. One can witness also direct exploitation of space opportunities by private business as in the case of Elon Musk's Space X and Jeff Bezos' Blue origins.

More broadly, a look at some statistics is telling in this regard. Features indicate the explosion of the economic potential in four areas especially.

[6] G. Petroni, D. G. Bianchi, *What Future for Regional Space Agencies?*, in *IspiOnline*, 2 June 2023.

[7] The World Factbook, *Space agency/agencies*, list available at https://www.cia.gov/the-world-factbook/field/space-agency-agencies/. D. Ireland-Piper, S. Freeland, *Human Rights and Space: Reflections on the Implications of Human Activity in Outer Space on Human Rights Law*, in *Groningen Journal of International Law*, 2021, 1, p. 112.

[8] I. Marboe, *National Space Law*, in F. von der Dunk, F. Tronchetti, *Handbook of Space Law*, cit., p. 127.

[9] C. Isnardi, *Problems with Enforcing International Space Law on Private Actors*, in *Columbia Journal of Transnational Law*, 2020, 2, p. 495. Apparently, the privatization of the sector was pushed by the Columbia disaster in 2003.

Satellites industry is by far the most relevant area, accounting for more than three-quarters of the overall space economy ($269 billion in 2017). Space launching services and space tourism are also promising fields ($10 billion and $20 billion respectively in 2017), since U.S. Federal Aviation Administration allowed commercial launches, although largely dominated by few corporations, namely Elon Musk's SpaceX whose "global market share of commercial launches is more than all other countries combined". The prospects of space mining are still uncertain but the spirit of the Artemis Accords, notably of its section 10[10], builds on estimates according to which the resources value of known asteroids thousands times the value of earth resources[11].

All these changes raise issues in relation to the actual realization of some very general principles of the Outer Space Treaty – benefit and interests of all countries (art. I), prohibition of national appropriation (art. II)[12], peaceful purposes (art. IV) – and to the legal constraints on the behaviour of private actors. These are indeed intrinsically prompted by private business rationales that are not necessarily in line with – and are able to hinder or stretch to their limits – the traditional principles of space law first set on the Outer Space Treaty. Nor these rationales are necessarily respectful of fundamental rights requirements.

Lastly, changes in the aims of the space race and in the actors involved is complemented by an evolution in the legal framework. Such evolution is both the consequence and the cause of the changes registered at the first two levels and has been aptly described by prominent authors in the field as the expression of a fourth phase of space law[13]. After the birth of space law with the very first UNCOPUOS Resolutions resulting in the binding corpus of founding Treaties, and subsequent evolution mainly through soft law instruments from the 1982 UNCOPUOS Resolution on direct broad-

[10] "1. The Signatories note that the utilization of space resources can benefit humankind by providing critical support for safe and sustainable operations.
2. The Signatories emphasize that the extraction and utilization of space resources, including any recovery from the surface or subsurface of the Moon, Mars, comets, or asteroids, should be executed in a manner that complies with the Outer Space Treaty and in support of safe and sustainable space activities. The Signatories affirm that the extraction of space resources does not inherently constitute national appropriation under Article II of the Outer Space Treaty, and that contracts and other legal instruments relating to space resources should be consistent with that Treaty"

[11] C. Isnardi, *Problems with Enforcing International Space Law*, cit., p. 495 ss.

[12] S. Zolea, *Esplorazione spaziale e nuove forme di appartenenza: spunti comparativi*, in *The Cardozo Electronic Law Bulletin*, 2020, 1, pp. 1-41.

[13] F. von der Dunk, *International Space Law*, cit., pp. 38-43 and p. 106 ss.

casting satellites to the 2010 UNCOPUOS Resolution on Space Debris Mitigation Guidelines[14], the legal landscape is now much more articulate.

On one hand, general treaties and UNCOPUOS soft law is being complemented by International Organizations' Special Legal Regimes and bilateral or multilateral agreements of a specialist nature: the Artemis Accords of October 2020 and currently signed by 43 States being an example of this, reflecting structural trends in international relations. On the other hand – and this is of particular interest when it comes to space law and fundamental rights, States are increasingly equipping themselves with sectoral (and in some cases, even general) national legislations touching upon the space field. The importance of domestic legislation – which is well explained based on what we observed so far in relation to the aims and the actors of the space race – is confirmed by the adoption on 11 December 2013 by the UN General Assembly of the Resolution containing "Recommendations on national legislation relevant to the peaceful exploration and use of outer space"[15]. The Resolution observes that "in view of the increasing participation of non-governmental entities in space activities, appropriate action at the national level is needed, in particular with respect to the authorization and supervision of non-governmental space activities". According to the UNOOSA National Space Law Database[16], at least 44 States (but this number understates real figures since submissions are made by States themselves) have some kind of national legislation relating to the exploration and use of outer space[17].

[14] https://www.unoosa.org/res/oosadoc/data/documents/2010/stspace/stspace49_0_html/st_space_49E.pdf

[15] https://www.unoosa.org/pdf/gares/A_RES_68_074E.pdf

[16] https://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/index.html. The UNOOSA also launched a new platform in 2022 on Accessing Space Treaty Resources Online (ASTRO), which serves as a database of national space laws, policies, and regulations of State members of COPUOS.

[17] There is a growing scholarly corpus on national space legislation: J. Hermida, *Legal Basis for a National Space Legislation*, Kluwer, 2004; R. S. Jakhu (ed.), *National Regulation of Space Activities*, Springer, 2010; F. G. von der Dunk (ed.), *National Space Legislation in Europe*, Martinus Nijhoff, 2011; I. Marboe, *National Space Law*, cit.; I. B. R. Supancana, *How the Progressive Development of Outer Space Law Affects the Formulation of National Space Legislation: The Experience of Indonesia*, in *Air & Space Law*, 2015, 1, pp. 93-106; P. Michielsen, *The Belgian Space Act: An Innovative Legal Safeguard to Boost the Space Industry*, Air & Space Law, 2016, 2, pp. 89-118; P. Hulsroj, Nakarada Pecujlic, *A. New in the Nest: The Danish Space Act*, in *Air & Space Law*, 2016, 6, pp. 503-510; A. Froehlich, V. Seffinga (eds.), *National Space Legislation. A Comparative and Evaluative Analysis*, Springer, 2018; J. Tapio, *The Finnish Space Act: En Route to Promoting Sustainable Private Activities in Outer Space*, in *Air & Space Law*, 2018,

3. *Space technologies as a threat on fundamental rights*

Based on the aforementioned contextual changes, it is important to understand how fundamental rights intertwine with space-related activities and the relevant technologies and what is the current state of their legal protection. A general preliminary observation is – as observed – the fundamental split between space law and fundamental rights discourse: there is no general framing of space law under the fundamental rights paradigm. This is not the case for international legal instruments of a binding nature, that are framed in general terms and provide very general principles[18], nor it is the case of the body of international soft law instruments[19]. Sure enough, such principles bear some relevance for the protection of fundamental rights, but the lack of conceptual clarity and the absence of any authority able to ensure the actual respect by Members States is a major obstacle to the realization of the "Rule of Law in Outer Space"[20].

If the current state of international relations does not seem to favour

4-5, pp. 387-410; L. J. Smith, R. J. M. Leishman, *Up, up and Away: An Update on the UK's Latest Plans for Space Activities*, in *Air & Space Law*, 2019, 1, pp. 1-26; Y. Ahn, *Recent Developments in the Republic of Korea's Space Policy: An Overview of Space Activities and National Laws*, in *Air & Space Law*, 2019, 2, pp. 169-184; J. Tapio, A. Soucek, *National Implementation of Non-Legally Binding Instruments: Managing Uncertainty in Space Law?*, in *Air & Space Law*, 2019, 6, pp. 565-582; K. Abhijeet, *National Space Legislation for India. Proposal for a Draft Framework*, Springer, 2020; M. Cocco, H. C. Mendonça, *The Portuguese Space Act: an Innovative Framework for Space Activities*, in *Air & Space*, 2020, 2, pp. 157-200; P. Mund, *'Tomorrow Is Today' for the Indian Space Saga: Delineating the Legal Framework for Space Activities in India*, in *Air & Space Law*, 2021, 1, pp. 119-134; M. Hoffman, *Entered into Force: The 2020 Space Law of Luxembourg*, in *Air & Space Law*, 2021, 4-5, pp. 587-602.

[18] Reference is here to the four "and a half" founding Space Law Treaties.

[19] Notably, the *Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space* (adopted on Dec. 13, 1963) (Resolution 1962 (XVIII)); the *Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting* (adopted Dec. 10, 1982) (Resolution 37/ 92); the *Principles Relating to Remote Sensing of the Earth from Outer Space* (adopted on Dec. 3, 1986) (Resolution 41/ 65); the *Principles Relevant to the Use of Nuclear Power Sources in Outer Space* (adopted on Dec. 14, 1992) (Resolution 4768); the *Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries* (adopted on Dec. 13, 1996) (Resolution 51/ 122).

[20] I. Kealotswe-Matlou, *The Rule of Law in Outer Space. A Call for an International Outer Space Authority*, in C. Steer, M. Hersch (eds.), *War and Peace in Outer Space*, Oxford University Press, 2021, pp. 91-106.

the development of such an institutional framework for the international protection of fundamental rights when it comes to space activities, this is where domestic legislation steps in within the larger space law "regime complex"[21]. Sure enough, the "Recommendations on national legislation relevant to the peaceful exploration and use of outer space" do not contain any reference to specific individual or collective rights, but emphasize – in view of the relevance acquired by non-governmental organizations in space activities – "the importance of appropriate means of ensuring that outer space is used for peaceful purposes and that the obligations under international law and those specifically contained in the United Nations treaties on outer space are implemented".

In particular, point 4 of the Recommendation states that "the conditions for authorization should help to ascertain that space activities are carried out in a safe manner and to minimize risks to persons, the environment or property and that those activities do not lead to harmful interference with other space activities". These are general statements, still they push national legislators to take into account in a more specific way the concrete implications of general international principles.

Environment, and environmental rights (right to a clean, healthy, and sustainable environment, and to intergenerational equity whereas we accept its existence as a legal principle), is the field where more attention has been devoted over time. It is almost superfluous to remind that Article 9 of the Outer Space Treaty holds that "States Parties to the Treaty shall pursue studies of outer space, including the moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose"[22].

The negative impact of space activities and relative concerns were thus apparent already decades ago. This is the case notably the issue of space debris[23]. What is involved here is not just space environment, with more

[21] The concept of "regime complex" identifies "an array of partially overlapping and nonhierarchical institutions governing a particular issue-area", L. Gómez-Mera *et al.*, *Global Governance for the Earth: Transforming Institutional Architectures in the Anthropocene*, Cambridge University Press, 2020, pp. 137-157. Space debris is definitely the most apparent issue when it comes to the right to a clean, healthy and sustainable environment, but also light pollution deriving from satellites overcrowding and hindering even the freedom of astronomical research, nuclear contamination, etc.

[22] See also Article 7 of the Moon Agremeent.

[23] L. Viikari, *The Environmental Element in Space Law. Assessing the Present and Charting the*

than 30.000 trackable debris, but also the Earth environment. Thus, few years ago news reported the fall of a large object from the sky on farm fields in Australia, supposedly from a Space X spacecraft[24]. Even though no damage was reported, this case questions the effects of space activities.

As a consequence, whereas national legislation has been adopted (either of a general nature or more often addressing specific areas of space law, such as licensing, registration and authorization frameworks), environmental protection has been incorporated. This is the case generally of any regulation aiming at debris mitigation, such as the US Federal Communications Commission Order on Mitigation of Orbital Debris[25], but also of other kinds of regulations, either specific or of a more general character. Thus, the UK Outer Space Act licensing conditions address "contamination of outer space or adverse changes in the environment of the earth"[26], while the US National Aeronautics and Space Act addresses any potential radiological impact of a launch to ensure the protection of public health and safety with regard to Space Nuclear Power and Propulsion[27]. The Ukrainian Law on Space Activity recalls standards for "environmental protection in the course of space activity" and prohibits the "use of space technology as a means of producing effects upon the environment for military purposes or other purposes posing a threat to humankind", as well as "presenting of a direct threat to the life and health of human beings and the causing of damage to the environment"[28]. Environmental protection in licensing

Future, Martinus Nijhoff Publishers, 2008, pp. 31-45; R. Tremayne-Smith, *Environmental Protection and Space Debris Issues in the Context of Authorisation*, in F. G. von der Dunk (ed.), *National Space Legislation in Europe Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation*, Martinus Nijhoff Publishers, 2011, pp. 179-188; F. Lyall, P. B. Larsen, *Space Law. A Treatise*, 2nd edition, Routledge, 2018, pp. 245-280 [ch. 10 Environmental Regulation]. A specific section (Section 12) is also devoted to space debris.

24 M. Ives, J. Gross, *A Large Object Landed on His Sheep Farm. It Came From Space*, in *New York Times*, 4 August 2022.

25 Order, FCC 04-130 *Mitigation of Orbital Debris*.

26 *Outer Space Act* 1986, Section 5(e).

27 *National Aeronautics and Space Act 1958* as amended by Chapter 201 of Title 51 on National Aeronautics and Space Programs. This is directly related to the UNGA Resolution 47/68 *Principles Relevant to the Use of Nuclear Power Sources In Outer Space*.

28 Articles 8 and 9 of *Law on Space Activity of 15 November 1996*, where it is also stated that "Space activity conducted under a specific project which has led to the loss of human lives, substantial material damage or substantial damage to the environment may be restricted or prohibited in conformity with the legislation of Ukraine currently in force". More environmental provisions are in articles 21, 22 and 23.

and authorization procedures is recalled in legislation of other countries, such as – just to mention some examples – Austria[29], Finland[30], France[31], Lietchenstein[32], Kazakhstan[33], New Zealand[34], Nigeria[35], Netherlands[36], Portugal[37], etc. Understandably, protection of the environment is also an important concern reflected in the Model Law of the ILA Committee on Space Law. According to its article 4(c), authorization is granted under the condition that "space activity does not cause environmental damage to the Earth and outer space", while the requirement of an environmental impact assessment follows from Article 7. Furthermore, article 8 identifies mitigation of space debris as an important concern.

If environmental protection, as a necessary element to make environmental rights effective, is today an essential component of space law that nobody puts into question[38], it is important to note that many of the aforementioned national regulations couple references to environmental protection with concerns relating to citizens' life or (physical) security, pub-

[29] Article 4 of *Law on Authorization of Space Activities and the Establishment of a National Space Registry* (*Austrian Outer Space Act*)

[30] Sections 5 and 10 of the *Act on Space Activities* (63/2018).

[31] Articles 4, 5 8 of the *French Space Operations Act, No. 2008-518 (2008)*.

[32] Articles 1 and 5 of *Act On the Authorization of Space Activities and the Registration of Space Objects* of 5th October 2023.

[33] Article 3 of *Law of the Republic of Kazakhstan on Space Activities* (No.528-IV of 6 January 2012).

[34] Sections 10, 18, 26 and ff. of the *Outer Space and High-altitude Activities Act 2017*.

[35] Article 9 of the *National Space Research and Development Agency Act 2010*.

[36] Sections 3, 6, 7 and 10 of the *Rules Concerning Space Activities and the Establishment of a Registry of Space Objects (Space Activities Act)*.

[37] *Decree-Law n. 16 on Legal regime of access to and exercise of space activities* of 22 January 2019. See also articles 15, 16 and 20 of the *Regulation n. 697 on access to and exercise of space activities* of 5 September 2019.

[38] As mentioned, only few national regulations are silent in this regard, but such silence is to be understood in relation to the level of involvement in space activities and of the development of space technologies of the relevant country.

lic health and safety, property[39] or the protection of the population[40]. These references reflect some elements of the notion of "damage" under Article I of the Liability Convention but also add something more, witnessing the "broad consensus that the protection of the environment "is a vital part of contemporary human rights doctrine and a sine qua non [essential element] for numerous rights, such as the right to health and the right to life"[41].

That said, one can observe that lack of reference to the protection of other rights, since the focus of domestic legislation in the area of space law is rather on national security and development concerns, in some cases framed under the general humankind-oriented principles. No reference is made for instance to threats to privacy[42]. The relevant rights (from privacy to data protection more specifically), which stems first from article 12 of the Universal Declaration of Human Rights[43], can however be hugely affected by Very High Resolution (VHR) remote sensing technologies[44]. One could just think for instance at the availability and easy accessibility of VHR data – some companies already provide commercial satellite imagery with resolutions allowing the identification of objects as small

---

[39] See e.g. Article 15 of Portuguese *Regulation n. 697* of 5 September 2019; Article 4 of French *Law n. 2008-518* of 3 June 2008 on Space operations, Section 10 of Sections 10, 18, 26 and ff. of New Zealand's Outer Space and High-altitude Activities Act 2017; Article 9 of Nigeria's *National Space Research and Development Agency Act 2010*; Section 3 of the Dutch *Rules Concerning Space Activities and the Establishment of a Registry of Space Objects (Space Activities Act)*; Section 4 of the *British Outer Space Act 1986*, and many others.

[40] See *Ukrainian Law on Space Activity* of 15 November 1996.

[41] D. Ireland-Piper, S. Freeland, *Space Law, Human Rights and Corporate Accountability*, cit., p. 17.

[42] S. Freeland, *The Regulation of Space Activities: a Human Rights Perspective*, in *Liber Amicorum Sergio Marchisio. Il diritto della comunità Internazionale tra caratteristiche strutturali e tendenze innovative*, Vol. II, Editoriale scientifica, 2022, p. 1067.

[43] "No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honour and reputation. Everyone has the right to the protection of the law against such interference or attacks".

[44] F. G. von der Dunk, *Europe and the 'Resolution Revolution': 'European' Legal Approaches to Privacy and their Relevance for Space Remote Sensing Activities, Space and Telecommunications*, *Law Program Faculty Publications*, Paper 35, 2009, pp. 809-844; F. G. von der Dunk, *Outer Space Law Principles and Privacy in Space, Cyber, and Telecommunications*, *Law Program Faculty Publications*, Paper 96, 2013, pp. 1-12; M. M. Coffer, *Balancing Privacy Rights and the Production of High-Quality Satellite Imagery*, in *Environmental Science Technology*, 2020, 54, pp. 6453-6455. On remote sensing, see, F. Lyall, P. B. Larsen, *Space Law. A Treatise*, 2nd edition, Routledge, 2018, pp. 359-386 [ch. 13 Remote Sensing].

as 30 centimetres – and its use from Google Earth Search Engine to law enforcement agencies. Risks are further aggravated by technological developments in the field of AI[45].

Generally speaking, international (space) law is not sensitive to the protection against the challenges for the right to privacy, which is also comprehensible given the different approaches to understanding the very status of these rights in the different areas of the globe (even though one should remind that according to the UN Principles Relating to Remote Sensing of the Earth from Outer Space, "[r]emote sensing activities shall be conducted in accordance with international law"[46], including article 12 of the UDHR). Possibilities for redress for individuals only lie in national legislation (or regional legislation, such as the EU GDPR)[47], which, besides possibly not being up to date with technological developments, bears in any case a fundamental asymmetry "between, on the one hand, cosmic generation and principled global availability of very high resolution data, and, on the other, localized privacy concerns and national means of protecting them"[48]. Yet privacy-related implications of space-based technologies have been taken into account, for instance, by the European Court of Human Rights[49].

4. *Space technologies and the promotion of fundamental rights*

The negative impact of space technologies and activities on fundamental

[45] D. Ireland-Piper, S. Freeland, *Human Rights and Space*, cit., p. 115.

[46] Principle III of the UNGA Resolution 41/65, *Principles Relating to Remote Sensing of the Earth from Outer Space*.

[47] D. Ireland-Piper, S. Freeland, *Space Law, Human Rights and Corporate Accountability*, cit., p. 16 s., referring in particular to Article 3(2)(b) and Article 3(3) of the European regulation. This should be read in conjunction with Principle IV of UNGA Resolution 41/65 *Principles Relating to Remote Sensing of the Earth from Outer Space* according to which the relevant "activities shall not be conducted in a manner detrimental to the legitimate rights and interests of the sensed State." See also C. Santos, L. Rapp, *Satellite Imagery, Very High-Resolution and Processing-Intensive Image Analysis: Potential Risks Under the GDPR*, in *Air & Space Law*, 2019, 3, pp. 275-296.

[48] F. G. von der Dunk, *Outer Space Law Principles and Privacy*, cit., p. 8.

[49] In recent case law, the Court stressed the need for balancing GPS tracking for national security reasons with privacy rights recognized by article 8 of the Convention, C. Candelmo, V. Nardone, *Satellite Evidence in Human Rights Cases: Merits and Shortcomings*, in *Peace Human Rights Governance*, 2017, 1, p. 103 ss.

rights is most often underlined. However, it is important to stress the positive dimension – what space technologies can do for the promotion of fundamental rights –, questioning whether and at what degree the existing legal framework intercepts it. As Steven Freeland observes, "the causal nexus between socio-economic development, incorporating the exploration and use of outer space, and the basic realization of human rights is […] increasingly evident"[50]. This is an extremely relevant perspective even though – one should admit – not an original one. In the end, the positive connection between space technologies and fundamental rights fully fits within the traditional principles of international space law: the benefit and common interests of all countries[51] and of all mankind[52], the maintenance of international peace and security and promotion of international co-operation and understanding[53], the peaceful purposes.[54] Also, "space law agreements manifest a particular interest on development, including social and cultural development"[55].

The Moon Agreement in particular refers to the promotion higher standards of living and conditions of economic and social progress and development[56]. This wording substantially replicates that of article 55 of the UN Charter[57] and some elements are affirmed in the International Covenant on Economic, Social and Cultural Rights of 16th December 1966. Thus, article 11 of the Covenant recognizes "the right of everyone to an adequate standard of living for himself and his family, including adequate food, clothing and housing, and to the continuous improvement of living conditions". In the end, the very establishment of the Committee

---

[50] S. Freeland, *The Peaceful Use of Outer Space*, cit., p. 48.

[51] Article 1 of the *Outer Space Treaty*.

[52] Principle I of the UNGA Resolution 1962 (XVIII), *Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space*.

[53] Article 3 of the *Outer Space Treaty*.

[54] Article 4 of the *Outer Space Treaty*.

[55] P. Tavernier, I. Kuskuvelis, *Space Law and Human Rights: a Complementary Relationship through the Right to Development*, in *Proceedings IISL*, AIAA, 1991, p. 350.

[56] Article 4 of the *Moon agreement*.

[57] Article 55 *UN Charter* (Chapter IX: International Economic and Social Cooperation): "With a view to the creation of conditions of stability and well-being which are necessary for peaceful and friendly relations among nations based on respect for the principle of equal rights and self-determination of peoples, the United Nations shall promote: higher standards of living, full employment, and conditions of economic and social progress and development; […]". This formula is recalled in other international instruments, such as the preamble of *Declaration on Social Progress and Development* approved by the UNGA on 11th December 1969.

on the Peaceful Uses of Outer Space is grounded on the possibility to gain major economic, social and cultural benefits from space technologies[58].

These principles and objectives are in turn strictly connected to the freedom of scientific investigation which is affirmed in Article 1 of the Outer Space Treaty and Article 6 of the Moon agreement, and more generally with the importance of favouring an environment that is conducive to the continuous development of a vibrant Space industry. It is therefore important to point out – by way of some examples – the multiple uses of space technologies able to promote the actual enjoyment of fundamental rights.

As mentioned before, satellites industry for different applications are nowadays the quantitatively most important part of space technology and have a huge potential to empower citizens' rights. The rights to freedom of expression and to information through satellite broadcasting and the right to education (in the era of distance learning for instance, when it comes to making internet connection available in remote areas as well, be it an island or the peak of a mountain) are among these as acknowledged by international instruments[59]. Thus, the Resolution on the Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting states that "activities should promote the free dissemination and mutual exchange of information and knowledge in cultural and scientific fields, assist in educational, social and economic development, particularly in the developing countries, enhance the qualities of life of all peoples and provide recreation with due respect to the political and cultural integrity of States"[60]. The UNESCO Declaration of Guiding Principles on the Use of Satellite Broadcasting for the Free Flow of Information, the Spread of Education and Greater Cultural Exchange, states that satellite broadcasting (which is defined as a 'means of disseminating knowledge and promoting better understanding among peoples') "shall be apolitical and conducted with due regard for the rights of individual persons and non-governmental entities, as recognized by States and international law", and that its objective "for the free flow of information is to ensure the widest possible dissemination, among the peoples of the world, of news of all countries, developed and developing alike".

It is possible to mention here also the huge impact for agricultural

[58] See *Actividades espaciales de las Naciones Unidasy las organizaciones internacionales* (A/AC. 105/358), United Nations, 1986.
[59] Articles 19 and 26 of the *Universal Declaration of Human Rights*.
[60] Principle 2.

development and the right to food[61], since space applications can deliver important information on climate and weather conditions, assist in efficient use of seeds, fertilizers, plant protection products, and water, help food distribution and supply[62]. Similarly, there are implications for the right to safety in relation to the prevention or the ex-post management of natural disasters. In this regard, the UN Principles on Remote Sensing mention the "the purpose of improving natural resources management, land use and the protection of the environment." Environment and related rights can also benefit from new technological applications[63]. These are just few examples of the manifold uses of space technologies for the furthering of fundamental rights and it would be definitely an interesting endeavour to provide a comprehensive overview. Here, we just limit at some considerations on the interception of this dimension by domestic legislation.

A quick analysis based on the UNOOOSA National Space Law Database[64] shows the lack of a uniform approach, with a group of countries – mostly developing countries from Latin America – incorporating references in their regulations establishing national space agencies or similar bodies. In most cases, references are generally made to benefits for social and economic development of the State or its citizens[65]. In some cases, detailed reference is made to specific uses, mostly in the environmental field[66]. In

[61] Article 25 of the *Universal Declaration of Human Rights*.

[62] I. Marboe, *The Contribution of Space Law in the Progressive and Full Realization of the Human Right to Food*, United Nations/Austria Symposium on Space Applications for Food Systems, 7 – 9 September 2021.

[63] For instance, courts started to rely on satellite data in environmental and other human rights cases, C. Candelmo, V. Nardone, *Satellite Evidence in Human Rights Cases*, cit. One could also mention Next generation solar powered satellite and terrestrial wireless charging technologies, https://www.internationalelectric.com/.

[64] https://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/index.html

[65] See for instance, Preamble of the *Decree of the Republic of Chile n. 338/2001 on the Establishment of a Presidential Advisory Committee* of 17 July 2001, known as the Chilean Space Agency; Preamble of the *Decree of the Republic of Colombia 2442/2006 on the Creation of the Colombian Commission of Space* of 18 July 2006; Section 4 of the *Canadian Space Agency Act 1990*; Article 6 of Nigeria's *National Space Research and Development Agency Act 2010*. The Preamble of Indonesia's Space Act mentions the "development of civilisation and the prosperity of the people of Indonesia and humankind in general", A. Froehlich, V. Seffinga (eds.), *National Space Legislation. A Comparative and Evaluative Analysis*, Springer, 2018, p. 96.

[66] Preamble and Article 3 of the *Decree n. 1246 on the Creation of the Ecuadorian Space Institute*; Preamble of the *Decree-Law of Republic of Portugal n. 16/2019 on the Legal regime of access to and exercise of space activities* of 22 January 2019; Article 2 of *Law n. 9960 on*

this regard, one of the most interesting examples comes from South Korea, both because the country made efforts to produce a comprehensive space legislation and because this legislation contains an articulate reference to such "promotional" dimension of space technologies that directly connects with the formulas used in international legal instruments. The Korean Space Development Promotion Act thus not only aims "to promote the peaceful use and scientific exploration of outer space, to ensure national security", but also "to further develop the national economy, and to raise the national standard of living through the systematic promotion of space development and the effective use and management of space objects"[67]. One might mention also Ukrainian legislation, for which "Space activity shall be conducted with the following aims: Furthering the socio-economic development and scientific progress of Ukraine and promoting the welfare of its citizens; Contributing to the solution of the general problems facing humankind; Establishing and maintaining space systems to ensure modern State information coverage; Fostering the development of education"[68].

5. *Conclusive remarks: legal and contextual weaknesses of fundamental rights in space law*

These pages described the relationship between space technologies and activities, and fundamental rights, highlighting two dimensions. On the negative side, space technologies and activities can breach fundamental rights, notably environmental rights, the rights to health and to life, and privacy rights: a bundle of rights that some frame under the unitary label of a right to live without physical or psychological threat from above[69]. On

the creation of the Costa Rican Space Agency; Article 2 of *Decree of the Republic of Chile n. 338/2001 on the Establishment of a Presidential Advisory Committee* of 17 July 2001 known as the Chilean Space Agency; Article 3(e) of *Decree of the Republic of Argentina n. 995/91 on the Creation of the National Commission on Space Activities* of 28 May 1991.

67 South Korea's *Space Development Promotion Act* of 31 May 2005. I. Marboe, *National Space Law*, cit., p. 168 s.

68 Articles 3 of *Law on Space Activity* of 15 November 1996.

69 N. Grief *et al.*, *The Airspace Tribunal: Towards a New Human Right to Protect the Freedom to Exist Without Physical or Psychological Threat from Above*, in *European Human Rights Law Review*, 2018, 3, p. 202; I. Ramuš Cvetkovič, *Two Sides of the Same Coin? Examining the Interrelation between the Proposed New Human Right and the Law Governing Outer Space*, in *Digital War*, 2024, 5, pp. 59-65.

the positive side, space technologies and activities show huge potential for the effectiveness of fundamental rights, notably second or third generation rights, by promoting social development. Yet, a fast review of the space law regime complex shows that, notwithstanding the existence of meaningful legal principles that conceptually connect to fundamental rights, these are still vague and fragmentary. This reflects the enduring decoupling between space law and fundamental rights.

This is not to say that fundamental rights are not relevant for space law, and an element thereof. International space law expressly – either directly or indirectly – incorporates fundamental (human) rights, from article III of the Outer Space Treaty to Principle 4 of the 1982 principles on direct broadcasting. Domestic legislation, even where it does not refer to fundamental rights, formally acknowledges those very same principles. Still, fundamental rights in space law suffer a double weakness.

First, significant normative voids continue to exist and the legal status of fundamental rights is fragile compared to concurring principles, such as that of national security and of commercial exploitation. The principles set in what can be termed as the Space Constitution, starting from the five founding treaties, are highly commendable but general and their interpretation not always clear in front of current developments of space opportunities. The conceptual relevance of fundamental rights for space law is in general not reflected in legal instruments, with the partial exception of the environmental dimension. While expanding, national legislation appears in general underdeveloped in this regard and this holds especially true as noticed for space-faring nations and for many of those who are equipping themselves for commercial exploitation of resources[70]. From a realistic perspective, this is quite understandable since national space legislation have specific rationales[71].

Second, there is a contextual weakness that explains the strictly legal weakness and the decoupling between space law and fundamental rights, that are reinforced by increased commercialization and privatization of space activities and by current Arms Race in Outer Space[72]. The challenge therefore is not (just) the formal incorporation of more or less specific provisions on the protection of fundamental rights. If many might agree

[70] S. Zolea, D. Germani, *Non militarizzazione e non appropriazione dello Spazio: un'analisi alla luce degli Artemis Accords*, in *Geopolitica*, 2023, 2, 338 s.

[71] T. Cakir, *Les législations nationales relatives aux opérations spatiales comme concrétisation d'une politique juridique*' in C. Bories *et al.*, *Droit de l'espace extra-atmosphérique. Questions d'actualité*, Presses de l'Université de Toulouse, 2021, pp. 15-30.

[72] S. Freeland, *The Peaceful Use of Outer Space*, cit., p. 47.

on the idea of recognizing a "right to live without physical or psychological threat from above" and an appropriate legal framework for the protection of fundamental rights is definitely crucial (which should also include an institutional framework for that purpose), the actual incorporation of fundamental rights in space law should not disregard two premises.

The first premise is about the object ("what"). Understanding the relationship between space law and fundamental rights in negative terms only – as much as important it is – entails a short-sighted perspective. In order to ensure the reconciliation between space law and fundamental rights, we must acknowledge the importance of fundamental rights' promotion and the centrality of a right to development in this regard, getting inspiration from the still current proposal put forth by Paul Tavernier and Ilias Kuskuvelis more than thirty years ago[73].

The second premise is more of a methodological nature (it is focused on the "how"). It is about the awareness that, due to the unstructured and fluid character of the space field, law and lawyers cannot achieve this reconciling task alone. This is put by Steven Freeland in the following terms: "[lawyers] simply do not have the tools to do so. All relevant stakeholders must exchange ideas, knowledge and expertise and understand how each can contribute to an appropriate future where space continues to play a vital role in the activities of humankind and does not represent a potential threat to our lives and livelihoods through irresponsible or reckless actions"[74]. In a way, the task today is more political than merely technical[75] – shaping the space legal field in Bourdieusian terms in order to establish a "nomos" expressing a new space awareness[76] – putting at its core the 'humanity' and 'common interest' doctrines underpinning space law and the developmental perspective, mindful of the responsibility of major spacefaring nations[77]. Only a clear (re-)framing in this direction

[73] P. Tavernier, I. Kuskuvelis, *Space Law and Human Rights*, cit.

[74] S. Freeland, *The Peaceful Use of Outer Space*, cit., p. 48.

[75] S. Zolea, D. Germani, *Non militarizzazione e non appropriazione dello Spazio*, cit., p. 339 s.

[76] F. Ruschi, *Ascesa e declino del corpus iuris spatialis. Un itinerario di filosofia del diritto internazionale*, in Dirittifondamentali.it, 2020, 1, p. 141.

[77] This it, it seems to me, the perspective evoked by S. Freeland, *The Peaceful Use of Outer Space*, cit. p. 48 s.: "It is important therefore to focus the language of space, and the underlying thinking about the regulation of space, towards activities that enhance capabilities and promote the peaceful uses of space, and away from the rhetoric of space as an area of conflict, military competition and, ultimately, as a domain of warfare. This is not easy—space has become even more geopolitical in nature, and current events

could challenge the efforts towards uncontrolled commercial exploitation and the attempts to apprehend space as a warfighting domain. This would also entail that space law "can no longer be circumscribed comprehensively as 'all legal instruments exclusively dedicated to outer space'. Its increasing down-to-earth importance – from communications to meteorology, from navigation to, yes, tourism – calls for space law to be now defined *lato sensu*, as *the collection of principles, norms and rules relevant for at least one particular branch of space activity, regardless of which particular sources they stem from*"[78].

To conclude on a lower and humbler tone, it seems to me that the analysis also indicates paths for research scholars. The question here has been put bluntly by Steven Freeland: "Why has there been so little work done as regards the human rights aspects of the exploration and use of outer space?"[79]. While this question is of certain interest and the answer could be partly found in these pages, I think it calls at two endeavours particularly: one is the systematic investigation of the interplay between space technologies and activities and fundamental rights, with regard to both the negative and the positive dimensions; the other is the answer to the question of "what legal and regulatory regimes best protect the broader interests of society on Earth without unduly restricting the development of appropriate space activities in the future"[80].

highlight that militaries will seek to use any technology that they perceive will advance their cause. Strong voices are required to emphasise the myriad human rights issues at stake". S. Freeland, R. S. Jakhu, The intersection between space law, cit., p. 237 in turn speak of a coordinated and comprehensive approach that recognizes the crucial role that space does and will play in the future sustainability of humankind.

[78] F. von der Dunk, *International Space Law*, cit., p. 121.

[79] S. Freeland, *The Peaceful Use of Outer Space: Protecting Life on Earth*, in *Digital War*, 2024, 5, p. 47.

[80] S. Freeland, *The Peaceful Use of Outer Space*, cit., p. 47.

Andrea Capurso

The Interplay between International Space Law and Domestic Legislations: New Issues, New Laws, New Solutions

Summary: 1. Introduction – 2. Regulating New Issues in National Space Laws – 3. The Value of States Regulatory Powers – 4. Harmonization Efforts: issues and Prospects – 5. Concluding remarks.

1. *Introduction*

Past and Present of Space-Law-Making

For the past twenty years, the international community has discussed the need for new rules of space law, trying to update the current legal framework to the evolving dynamics of space activities.

This discourse has been prominently featured in the annual meetings and reports of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS)[1], which has been a key platform for the development of space law. Two alternative approaches have characterized the discussion: reinforcing and updating existing treaties or, alternatively, formulating new agreements to address contemporary challenges[2].

However, the geopolitical context has never offered the right conditions for transforming either of the two approaches into reality. Too many factors hindered the way, from the contrasting positions of States regarding

[1] COPUOS was established in 1959 by the UN General Assembly to oversee international cooperation in the peaceful use and exploration of space and to represent a forum of discussion among States on various matters relating to space activities.

[2] For example, most recently, the UN has proposed developing new normative mechanisms to address modern space challenges, focusing on ensuring cooperation, sustainability, and preventing an arms race in outer space. This proposal, outlined in the policy brief titled «*For All Humanity - The Future of Outer Space Governance*», is part of preparations for the UN Summit of the Future scheduled for September 2024. See United Nations, *For All Humanity-The Future of Outer Space Governance*, in Our Common Agenda Policy Brief no. 7, 2023, p. 14.

their national interests, to their different economic ambitions, from the divergence in their strategic security concerns, to the lack of trust between major space players.

Thus, the past two decades have been characterized by a cautious approach to international space law making, where States have preferred bilateral arrangements (e.g. the Artemis Accords) or less binding international frameworks (e.g. the Long Term Sustainability Guidelines) to avoid the complexities of amending the space treaties or adopting a new one.

This is also the consequence of a much different scenario within COPUOS compared to the treaty-making era of space law, where the UN was excellently driving forward the regulation of space matters.

COPUOS is not the same forum that operated in the 1960s and 1970s: its membership has more than doubled since then. Naturally, with more seats in the Committee the divergence of priorities and interests among its members has followed and, therefore, a less favorable condition for the adoption of a multilateral binding instrument has formed.

Uninterested in the slowness and hinders of the Law, space technology has advanced, and new actors, both public and private, have entered the realm of extraterrestrial operations, leading to the so-called «democratization» and «commercialization» of outer space.

These processes have opened up new possibilities in the activities that humans are able to perform beyond the atmosphere. Endeavors once thought unfeasible are now a reality.

The result is that the gap between space technology and space rules has widened, the level of uncertainties on the application of the international legal framework has worsened, and the risk of conflicts has inevitably increased.

Legal Pluralism

In this scenario, spacefaring States have not remained static. In view of the inefficiency of international lawmaking bodies, they resorted to a pragmatic regulatory solution to the new technological challenges: the adoption of national space legislations.

The latter allow for the speedy regulation of new space activities at the domestic level based on the exercise of States' regulatory powers. As a result, this legislative practice has found great fortune in recent times. According to the UN database on national space laws, forty-three States as of October 2023 have adopted domestic legislations that provide definitions, interpretations of treaty principles, and actual rules on new uses of the cosmic environment.

The problem is that they do so unilaterally and with little international coordination. Thus, space law is today affected by a dangerous trend of pluralism, which can be particularly troublesome when applied to an international area where actors under different jurisdictions interact.

In view of all this, a number of questions arise: 1) How do national space laws regulate new issues related to space activities? 2) What is the value of such regulations for the interpretation and application of the space treaties? 3) Can the harmonization of domestic legislations represent the solution to the fragmentation of contemporary space law?

The present paper delves into these issues from the perspective of international law. In Section 2, it begins with a description of how some national space laws have addressed open issues of the space treaties, such as the delimitation of outer space, the use of space resources, and the conditions for authorization of private space activities and registration of private space objects.

The relationship between such domestic norms and the norms established at the international level is the object of Section 3. The latter elaborates on the value of legislative State practice under the Vienna Convention on the Law of Treaties[3] (VCLT) of 1969, looking at the possible classification of national space legislations as subsequent practice.

Finally, Section 4 brings the discourse on the attempts to harmonize domestic space laws. It looks first at the efforts made at the UN level in the past twenty years, especially through guidelines and recommendations. It examines then the proposal of a EU Space Law, which may represent the first example of a regional space law in the world.

The paper concludes with some final remarks on how the space treaties should be interpreted today in light of the bottom-up and top-down legal processes described in the previous sections.

2. *Regulating new issues in national space laws*

The Scope of Application of Space Law

It is beyond the scope of the present paper to address in depth the various national space legislations in force today. Scholars and commentators have produced a large amount of literature on the matter[4],

[3] Vienna Convention on the Law of Treaties (VCLT), 23 May 1969, 1155 UNTS 331.

[4] See the contributions of: F. Von der Dunk, *National Space Legislation in Europe*, Brill, 2011; A. Froelich et al., *National Space Legislation: A Comparative and Evaluative*

describing and comparing the framework of spacefaring States, either by looking at one specific aspect of their space laws (e.g. remote sensing or launching capabilities) or by providing a general overview of how space activities are regulated domestically[5].

The aim of the present section is different: it is to analyze the particular provisions in selected national frameworks that have tried to tackle the new issues of space law.

A first aspect that has become increasingly problematic in recent times is the absence in the space treaties of a norm that defines the scope of application of space law.

Put simply, which activities fall under air law and which ones under space law?

Considering that aircraft and spacecraft have traditionally operated at enormous distances in height, the question has remained unanswered at the international level for the past seventy years.

Today, however, there are activities that are performed in the part of the atmosphere between the altitude at which aircraft fly and the altitude where satellites orbit around Earth.

In particular, suborbital activities have transitioned from their experimental phase to their operational phase[6]. This has brought novel

Analysis, Springer, 2018, P. Dempsey, *National Laws governing Commercial Space Activities: Legislation, Regulation, & Enforcement*, in Northwestern Journal of International Law & Business, Vol. 36, No. 1, 2016; I. Marboe, *National Space Law*, in Handbook of Space Law, Edward Elgar Publishing, 2015.

[5] See for example the literature on the French space legislation: Schmidt-Tedd et al., *The French Act relating to space activities. From international law idealism to national industrial pragmatism*, in ESPI Perspectives No 11, 2008; G. Carminati, *French National Space Legislation: A Brief Parcours of a Long History*, in Houston Journal of International Law, Vol. 36, No. 1, 2014. See P. Clerc, *Space Law in the European Context: National Architecture, Legislation and Policy in France*, Eleven Int. Publishing, 2018. Similarly for the UK space law, see: L. Smith et al., *Up, up and Away: An Update on the UK's Latest Plans for Space Activities*, in Air and Space Law, Vol. 44, no 1, 2019; C. Housley et al., *The UK Space Industry Act*, in House of Commons Library Briefing, Number CBP 2021-9202, 2021. Other examples are: M. Mineiro, Law and Regulation Governing *US Commercial Spaceports: Licensing, Liability, and Legal Challenges*, in Journal of Air Law and Commerce, Vol. 73, No. 4, 2008; A. Kerkonian, *Space Regulation in Canada: Past, Present and Potential. The Case for a Comprehensive Canadian Space Law*, Springer, 2021.

[6] Suborbital flights consist in controlled flights of objects moving at a suborbital speed, namely, a speed lower than that required to put a satellite into orbit. See UN COPUOS Doc. A/AC.105/C.2/2022/CRP.24, p. 4. In analogous terms, ICAO Doc. LC/36-WP/3-2 20/10/15, p. 2: *A sub-orbital flight is a flight up to a very high altitude which does not involve sending the vehicle into orbit*.

interest in the demarcation between the two fields of law, raising issues on the identification of the applicable regime[7].

Applying air law to an activity has substantial consequences on its regulation.

Firstly, air law is based on the principle of sovereignty of the air, which is a firmly established and longstanding tenet of customary international law according to which sovereignty extends to the airspace above the territory (and territorial waters) of States[8]. Hence, flying over another State's territory without permission is a violation of its territorial sovereignty[9].

Secondly, air law has a detailed private law regime addressing second- and third-party liability of the operator vis-à-vis passengers and third parties on the ground[10].

Thirdly, air law includes a stringent set of rules on safety measures and certifications necessary to operate an aircraft. They cover different aspects, from the airworthiness, to the design and operation of aircraft; from the international traffic management to the security and behaviour of passengers on board[11].

If space law applies, on the other hand, the regime changes radically.

In fact, space law is based on the principles of free use, free access and

[7] As it is aptly specified by T. Masson Zwaan, *Private Law Aspects of Suborbital Flights: Second- and ThirdParty Liability and Insurance*, in Journal of Air Law and Commerce, Vol. 87, No. 3, 2022, p. 417: «*If suborbital flights do not cross borders, national law will apply. In the case of vertical launch vehicles, such as Blue Origin's New Shepard, there is no crossing of borders or overflight of foreign territory, and thus states can regulate the activity in the framework of national law - whether that is air law, space law, or a new hybrid law. For vehicles launched from an aircraft, such as Virgin Galactic's flights, the solution may be less evident. Borders could be crossed, especially during flights originating in countries smaller than the United States such as those in Europe in which international law may apply*».

[8] Chicago Convention of 1944, art. 1. This principle has been recognized by the ICJ as a «*firmly established and longstanding tenet of customary international law*» in *Military and Paramilitary Activities in and against Nicaragua* (Nicaragua v United States of America), ICJ Rep 14, 1986, para. 212.

[9] Chicago Convention of 1944, art. 3(d).

[10] See Convention for the Unification of Certain Rules for International Carriage by Air, 1999, 2242 U.N.T.S. 309. See also Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface, 1952, 310 U.N.T.S. 181. For a detailed analysis of the matter see T. Masson Zwaan, above at 7.

[11] See the Annexes of the Chicago Convention, such as Annex 6 on the operation of aircraft, and Annex 19 on safety management. See also the ICAO's Standards and Recommended Practices (SARPs), which – while not treaties themselves – are referenced in the annexes to the Chicago Convention and cover a wide range of safety and security aspects of aviation, including licensing, operation of aircraft, and aerodrome design and operations.

non-appropriation[12], which render outer space a *res communis omnium*, beyond the territorial sovereignty and jurisdiction of States[13].

Moreover, in case of damages caused by a space object the launching State is internationally liable, meaning that there is no direct liability of private operators for space activities. Only States can present a claim, while private third parties are not entitled to. In addition, a two-tier regime of liability applies pursuant to which liability is absolute if compensable damage occurs on the Earth's surface or to an aircraft in flight, but it is fault-based if damage occurs somewhere else[14].

As for safety regulations, space law has not developed any binding regulation on the safety of space activities nor on its traffic management, leaving it up to States to ensure nationally safe and coordinated space operations.

In view of this brief recollection of the main differences between the two regimes, it can be seen how the choice of the applicable law in case of suborbital flights is essential.

With both air law and space law still silent on the matter, some States have decided to take a stance.

Australia[15], Malaysia[16], Denmark[17], and Kazakhstan[18] indicated in their national laws that outer space is an area beyond the distance of 100 km above mean sea level[19]. The United Arab Emirates used a slightly different demarcation point defining space activities as «*activities targeting an area above 80 km of altitude*»[20].

[12] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 1967, 610 U.N.T.S. 205, Articles I and II.

[13] See A. Capurso, *The End of Res Communes Omnium*, in A new role for Roman taxonomies in the future of goods? (ed. by M. Falcon e M. Milani), Jovene, 2023, pp. 59-90.

[14] See T. Masson-Zwaan, above at 7, p. 431.

[15] Australian Space (Launches and Return) Act of 2018, Section 8.

[16] Malaysian Space Board Bill of 2022, Section 2.

[17] Danish Outer Space Act of 2016, Article 2.

[18] Law of the Republic of Kazakhstan on Space Activities of 2016, Article 1.

[19] The choice of 100 km above the surface of the Earth – also known as the Von Karman line – is the fruit of a scientific analysis of the atmosphere in relation to aviation and space activities. In particular, this is the general altitude where the atmosphere is so thin that aircraft wings cannot generate sufficient lift for flight, while a spacecraft cannot orbit because the atmospheric drag is excessive.

[20] Federal Decree Law No. 46 of 2023 Regarding the Organization of the Space Sector, Article 3.

As a consequence, there are five States in the world where outer space has an inner border and where the regime of space law does not apply below the chosen demarcation line. Considering that launching an object beyond that line triggers the application of the regime of space law, it follows that suborbital activities are regulated according to the principles of the space treaties.

In this context, if an EU Member State decides to regulate them under the regime of aviation law, then for example a roundtrip suborbital flight from Italy to Australia will inevitably create conflicts of law.

The Appropriation of Space Resources

Another example of national provisions unilaterally addressing unsolved issues of international space law can be found in the regulation of space resources appropriation.

Article II of the Outer Space Treaty (OST) stipulates: «*Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means*».

From a plain interpretation of the provision, it is clear that sovereignty claims of any kind and through any means are prohibited in outer space. For instance, the orbits around Earth cannot be owned because a satellite is placed there, nor the areas of the Moon can become the territory of any State.

This principle is also known as the non-appropriation principle.

It builds upon an old principle of Roman law according to which certain domains are non-appropriable because they must remain common to all. Such domains represent a complex legal category made of two distinctive aspects: a container and a content, one non-appropriable, the other *res nullius*[21].

Translated in terms of space law, this means that, for example, the Moon is non-appropriable and, therefore, is a container, but the resources contained therein are freely accessible and usable as they are *res nullius*.

While it is widely accepted that space resources can be the object of property rights, the international community has not yet established an agreed set of rules on how their exploitation can be performed. The substantial right is generally recognized, but the manner in which it has to be exercised – especially for commercial purposes – requires a proper legal

[21] A. Capurso, *The Non-Appropriation Principle: A Roman Interpretation*, in Proceedings of the International Institute of Space Law 2018, Eleven International Publishing, 2019, pp. 111-127. Available at the following link: https://iislweb.org/awards-and-competitions/diederiks-verschoor-award/

framework.

In 2022, the Working Group on Legal Aspects of Space Resources Activities – established under the auspices of the UN Committee on the Peaceful Uses of Outer Space (COPUOS) – proposed a five year work plan to formulate a set of principles on space resources activities[22]. The issues on the desk of the working group are: the legal risk and uncertainty for private investments in commercial projects; the equitable access to space resources for all States without discrimination; the mechanisms to avoid conflicts between actors; the sustainability of space exploration missions (public and private); the development of an independent international framework to govern space resources activities[23].

Even if the creation of internationally agreed rules on the commercial utilization of space resources is still a work in progress, some States have nonetheless decided to offer to private operators the legal basis for their extraction, appropriation and commercialization.

For example, the USA in the so-called «*Commercial Space Launch Competitiveness Act*» of 2015 has established that: «*A United States citizen engaged in commercial recovery of an asteroid resource or a space resource under this chapter shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource obtained in accordance with applicable law, including the international obligations of the United States*»[24].

Similar provisions have been adopted by Luxembourg[25] in 2017, by United Arab Emirates[26] in 2019 and by Japan[27] in 2021.

It follows that a private entity can obtain the necessary authorization to exploit and commercialize space resources in any of those four States.

This legislative practice is a form of shaping new rules: if the international community does not find an agreement on the manner through which space resources will be appropriated and commercialized,

[22] Co-Chairs' Proposed Five Year Workplan and Methods of Work for the Working Group on Legal Aspects of Space Resource Activities (2022).

[23] Report of the Committee on the Peaceful Uses of Outer Space, Sixty-fourth session (25 August - 3 September 2021), A/76/20, p. 25.

[24] US Commercial Space Launch Competitiveness Act, Pub L No 114–190, 129 Stat 704, 2015, Section 51303.

[25] Loi du 20 juillet, 2017 sur l'exploration et l'utilisation des ressources de l'espace, 2017, Articles 1 and 3.

[26] United Arab Emirates Federal Law No. 12 of 2019 on the Regulation of the Space Sector, 2019.

[27] Japan Space Resources Act (2021), Article 5.

the unilateral vision of the most advanced States will be predominant, setting precedents and influencing the future legal framework for space resource utilization on a global scale.

The Relationship between Private Space Activities and States

One last example of national laws implementing the space treaties without international coordination can be found in the conditions for regulating the relationship between public authorities and private actors at the national level.

The OST, with three ill-phrased and badly coordinated provisions, has established the guiding principles on such relationship.

In particular, Article VI has established an international obligation for the «*appropriate State*» to authorize and supervise the operations of private actors in outer space for the purpose of assuring their conformity with the applicable legal framework. Article VII has introduced a specific category of the so-called «*launching State*», which is the State(s) liable for damages produced by space objects, whether they are public or private, launched from its territory or facility or that the State itself launched or whose launch it procured. Finally, Article VIII has maintained the principle that if a State registers an object on its national registry «*retains jurisdiction and control*» over it.

The implementation of such provisions at the national level requires the adoption of normative acts where States must set up the conditions under which: 1) private operators can be authorized to perform space activities; 2) their activity can render a State a launching State; 3) their object can be registered in the national registry.

Although the general structure of national space laws is today always quite similar, certain elements are left to the discretion of States. This is a natural condition when international obligations are implemented. However, in the absence of any coordination, States have created a patchwork of legal standards, influenced by the time in which they drafted their laws as well as by the needs of their industrial sector[28].

[28] For example, Norway passed the first national space law regarding the activities of private actors already in 1969, limiting its scope of application to the need to have a permit in order to launch a space object from Norwegian territory. States that have adopted laws at a later stage have adapted their content to the needs of their private space industry at the time of drafting. The last State that have regulated the activities of non-governmental entities in outer space is Lichtenstein – whose law entered into force on January 1st, 2024 – who has regulated in detail several aspects of private operations, from insurance coverage to sustainability requirements, to the conditions for completing a change of operator or control of the space object while in orbit.

For instance, different States have adopted different positions on when their laws on the authorization and supervision of private space activities applies, and therefore on when they consider themselves responsible at the international level.

Some national space laws apply in connection to the nationality or to the presence of private actors on the territory of the State[29], some others have excluded their application to nationals conducting space activities abroad[30].

Moreover, State have considered in different manners their connection to private missions for the purpose of becoming a launching State or the State of registry.

Moving to the conditions for authorizing and supervising private space activities, States have established different requirements on their sustainability, but they have also set different liability caps for damages caused by private space objects and requested different maximum insurance coverage to operators.

Thus, the normative landscape applicable to private actors changes significantly depending on the jurisdiction from which they manage their space activity.

There is a principle that perfectly applies to this kind of situations: the heavier a regulatory framework is, the less attractive it is for the industry. Therefore, it is clear how the lack of international guidance allows a race to the bottom in the regulation of private space activities. And this is a dangerous condition in an international environment like outer space where actors from different jurisdictions interact and share the same domain.

All this shows how the implementation of international space law at the domestic level is becoming increasingly fragmented. For this reason, it is necessary today to understand what is the value of the individual regulatory choices of States for the interpretation and application of the space treaties.

Are national space legislations a foundation or a challenge to the establishment of a cohesive international regime of space law?

[29] See the Finnish Law n. 63/2018 - *Act on Space Activities*, Section 1.

[30] See the Dutch law titled: *Rules Concerning Space Activities and the Establishment of a Registry of Space Objects*, entered into force on 1.1.2018, Section 2.

3. *The value of states regulatory powers*

Subsequent Practice

When the meaning of a treaty provision is unclear, recourse must be had to the international means of interpretation, enshrined today in Articles 31 and 32 of the VCLT.

They are generally indicated as the textual, contextual, and teleological approach, but they include also the analysis of the subsequent practice of States with regard to the provision under scrutiny[31]. For the purpose of the present paper, the latter is the one that matters.

The expression subsequent practice, in the broad sense, covers any application of the treaty by one or more parties[32]. It can take various forms: it may consist of a direct application of the treaty in question, or a statement or judicial pronouncement regarding its interpretation or application; it may include official statements concerning the treaty's meaning, protests against nonperformance, or tacit acceptance of statements or acts by other parties[33]. Most importantly, it may include State legislation[34].

A first perspective under which the subsequent practice of States comes to relevance is mentioned in Article 31(3)(b) of the VCLT:

«*There shall be taken into account, together with the context: […] (b) any subsequent practice in the application of the treaty which establishes the agreement of the parties regarding its interpretation*»[35].

The problem of using this provision in the context of space law is that it concerns not just any subsequent practice, but only the one that establishes the agreement of the parties.

This means that such practice must reveal a common intent of the parties with regard to the interpretation of the treaty. Even if only some States have assumed a certain conduct – e.g. a particular legislative implementation of a treaty provision – the other parties must nonetheless

---

[31] VCLT, Article 31. See for all A. Orakhelashvili, *The interpretation of acts and rules in public international law*, Oxford University Press, 2008, p. 301.

[32] See ILC, Draft Conclusions on Subsequent Agreements and Subsequent Practice in Relation to the Interpretation of Treaties, in Report of the International Law Commission 70th Session, UN Doc. A/73/10 of 2018 (hereinafter: Draft Conclusions).

[33] ILC, Report on the work of the sixty-fifth session, UN Doc. A/CN.4/SER.A/2013/Add.1 (Part 2), Chapter IV, Subsequent agreements and subsequent practice in relation to the interpretation of treaties, p. 34 (hereinafter: ILC Report).

[34] See I. Brownlie, *Principles of Public International Law*, Oxford University Press, 2003, p. 6.

[35] VCLT, Article 31(3)(b).

show their acceptance of such conduct, demonstrating explicitly or implicitly that they embrace the same intent[36].

In view of that, it would be difficult to sustain that the national space laws analyzed in the previous Chapter represent the agreement of the States Parties to the OST. To the contrary, they reflect precisely the discord between spacefaring States on how certain aspects of space law should be regulated at the domestic level.

Neither the national laws on the scope of application of space law, nor the ones on the commercialization of space resources, nor the ones setting the conditions for authorizing and supervising a private space activity can be considered as establishing the agreement of the parties according to Article 31(3)(b) of the VCLT. As it was shown, depending on the jurisdiction taken into consideration different solutions can be found.

Therefore, the national space laws tackling those issues cannot constitute a means of interpretation pursuant to Article 31 of the VCLT.

Nonetheless, the subsequent practice of States may be relevant also under Article 32 of the VCLT, which maintains that: «*Recourse may be had to supplementary means of interpretation, […] to determine the meaning when the interpretation according to article 31: (a) leaves the meaning ambiguous or obscure; or (b) leads to a result which is manifestly absurd or unreasonable*»[37].

Unlike the subsequent practice mentioned in Article 31, the one that can be subsumed under the supplementary means of interpretation does not have to be uniform[38]. To the contrary, even the practice of only some States may be relevant for the purpose of applying Article 32[39].

The jurisprudence of international tribunals have made use of this mechanism in several occasions. For example, the International Court of Justice in the Kasikili v. Sedudu Island case has referred to Article 32 and in particular to the internal document of only one State involved in the dispute to support an interpretative conclusion that the Court had reached through other means of interpretation[40]. Also the European Court of

[36] For a detailed analysis of this form of subsequent practice see E. Feola, *Il Ruolo della Prassi Successiva delle Parti nell'Interpretazione dei Trattati*, PhD Thesis, University of Naples Federico II – Law Department, 2011.

[37] VCLT, Article 32.

[38] S. Kadelbach, *The International Law Commission and role of subsequent practice as a means of interpretation under Articles 31 and 32 VCLT*, in QIL - Zoom-in, Vol. 46, 2018, p. 6.

[39] ILC Draft Conclusions, Conclusion 4(3): *A subsequent practice as a supplementary means of interpretation under article 32 consists of conduct by one or more parties in the application of the treaty, after its conclusion*.

[40] See ICJ, *Kasikili v. Sedudu Island*, Judgrnent, I.C.J. Report 1999, p. 1096, para. 80.

Human Rights and the Inter-American Court of Human Rights have often relied as a means of interpretation on partial subsequent State practice by referring to national legislation and domestic administrative practice of only some States to support their interpretations[41].

Under this light, the domestic space legislations of certain States may be relevant for the purpose of interpreting the OST.

For example, if an international tribunal were to reach the conclusion that the concept of launching State under Article VII of the OST applies only to States and not also to private actors procuring the launch of a space object, it could use as a supplementary means of interpretation the legislation of the Netherlands which does not consider the procurement of a launch by a private party to require a license[42].

However, there are two caveats that cannot be ignored.

First, one must remain conscious of the fact that the view of one State does not make international law: the relevance of a single domestic approach to an international issue can only be relevant as a supporting element in the work of the interpreter.

Second, in cases of excessive discordance in the domestic implementation of international obligations, the value of the subsequent practice becomes inevitably weaker and recourse to Article 32 is more problematic, even if used only to support an interpretative conclusion reached through other means.

Going back to the example on the correct interpretation of launching State under Article VII of the OST, an international tribunal may reach the exact opposite conclusion compared to the one described above using as supporting subsequent practice the domestic legislation of the UK, where private actors procuring the launch of a space object are required to obtain a license[43].

This is the current situation of national space legislations, which are characterized by an increasing variety of solutions to the open issues of

---

[41] See the vast jurisprudence mentioned in the ILC Report, p. 32.

[42] See F. Von der Dunk, *Regulation of Space Activities in The Netherlands*, in Space, Cyber, and Telecommunications Law Program Faculty Publications, Vol. 61, 2010, p. 237. See also T. Masson-Zwaan, *Widening the horizons of outer space law*, Meijers-reeks, 2023, commenting the Dutch Space Activities Act as follows: «*A particularity of Dutch State practice is that the Netherlands does not consider itself as launching State for satellites launched abroad for Dutch private entities. Instead, its understanding of the term 'to procure a launch' is that this only applies when the government itself procures a launch for a governmental satellite, as was the case for the Brik II military satellite, launched in 2021*».

[43] See UK Outer Space Act, Section 1(a).

international space law, relativizing its application and undermining its effectiveness.

In this context, neither under Article 31 nor under Article 32 of the VCLT national space laws appear as an efficient instrument of interpretation for the purposes of solving the issues presented in the previous Chapter.

General Practice Accepted as Law

Even if the application of Article 32 has its challenges, it must be remembered that national space laws are not only a means for interpreting international norms pursuant to the VCLT. They can assume an autonomous value as evidence of State practice for the purpose of individuating new rules of customary nature.

Under this light, rather than an interpretative function, they serve the purpose of filling the gaps left by the international legislator in the regulation of space activities.

In the previous Chapter, it was shown how some States have defined the scope of application of space law in their jurisdiction and how some others have envisaged the rights to commercialize space resources for their private actors. These stances – expressed using domestic regulatory powers – do not represent interpretations of the OST, because the aspects that they regulate are not even touched by the treaty. Instead, they appear as law-making measures, establishing unilateral rules where the international legislator has remained silent.

In the lack of an international legal framework, States have the faculty to determine what they consider the applicable law to a certain activity simply though their conduct, manifested for example by a domestic legislative act.

Before the conduct of States forms a rule of customary nature, it is necessary to ascertain whether there is a general practice reflecting that conduct, and whether such general practice is accepted as law – that is, accompanied by *opinio iuris*[44]. This two-element approach applies to the identification of the existence and content of rules of customary international law in all fields of international law, taking into account the particular circumstances and context in which an alleged rule has arisen and operates[45].

As far as space law is concerned, the legislative conduct of some States allows to see the prospect for the formation of new rules of customary nature.

[44] ILC, Draft conclusions on identification of customary international law with commentaries, in Report of the International Law Commission 70th Session, UN Doc. A/73/10 of 2018, Chapter V, p. 125.

[45] *Ibid.* p. 126.

Take for example the principle allowing the commercialization of resources extracted from the Moon and other celestial bodies without an international regime (such as the one for the Area on the ocean floor): after having established such principle in its domestic legislation, the USA has elaborated the so-called Artemis Accords. The latter is a non-binding political commitment that the USA has drafted for other States to sign without the possibility to negotiate its content. Among the provisions contained therein, it is possible to find the recognition of the possibility to use space resources for commercial purposes[46].

This recognition is significant, considering that the Artemis Accords include also the following statement: «*The Signatories intend to use their experience under the Accords to contribute to multilateral efforts to further develop international practices and rules applicable to the extraction and utilization of space resources*».

As f May 2024, there were 42 signatories of the Artemis Accords.

This means that the commercialization of space resources as an agreed principle of space law is acquiring increasing acceptance, which in time may become evidence of the formation of a new rule of customary nature.

Nonetheless, the context in which this principle has arisen is far from undebated: the unilaterally recognized commercialization of space resources has received the open opposition of several States[47]; moreover, there is an international treaty signed by more than 20 States[48] – i.e. the Moon Agreement of 1979[49] – that requires the establishment of an international regime to govern the exploitation of the natural resources of the Moon based on the principle of benefit-sharing[50]; finally, the already-mentioned Working Group on Legal Aspects of Space Resources Activities is currently working on a proposal for a legal framework on space resources, including possible rules on their commercial utilization[51].

All this challenges the emergence of a rule of customary nature based on the legislative choice promulgated by the USA and spread among other

[46] See Artemis Accords, 2020, Sections 5 and 10.

[47] See for all the submissions to the Working Group on Legal Aspects of Space Resource Activities by the Russian Federation and by China, respectively indicated as UN Doc. A/AC.105/C.2/2023/CRP.20 of 2022 and as UN Doc. A/AC.105/C.2/2024/CRP.5 of 2024.

[48] See the Status of International Agreements relating to activities in outer space as at 1 January 2023, in UN Doc. A/AC.105/C.2/2023/CRP.3 of 20 March 2023.

[49] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement), entered into force on 11 July 1984, 1363 UNTS 3.

[50] *Ibid.*, Article 11.

[51] See Co-chairs Co-Chairs' Proposed Five Year Workplan, above at 22.

spacefaring States through the Artemis Accords.

With that said, it is evident how domestic space laws have the potential to set forth – with the right conditions – new rules of general international space law. Their customary law-making function represents a solution for the advancement of space law and for its adaptation to new unregulated issues. However, their effectiveness is troubled by the inherent difficulty of reaching an agreed acceptance among the international community on the formation of new customary norms. This is evidenced by the contestations of States for the unilateral proposition of new rules of space law and – most importantly in the present discussion – by the lack of coherence among domestic space legislations.

In this context, the exercise of States' regulatory powers with regard to the new legal issues raised by private space activities has only one immediate result: the fragmentation of international space law, to the detriment of all private operators and with the risk of tensions between States.

4. *Harmonization efforts: issues and prospects*

International initiatives

In response to the challenges posed by the proliferation of national space laws and the fragmentation of the international legal framework, there have been efforts to harmonize and coordinate space regulations. These harmonization efforts aim to promote consistency, coherence, and cooperation among States in the regulation and governance of space activities.

It is possible to distinguish between three different roads where harmonization efforts take place.

The first one is under the aegis of the UN. Since the early 2000s, COPUOS has started working on initiatives that could bring more uniformity in domestic legislative trends. The most notable examples are the recommendations on enhancing the practice of States and international intergovernmental organizations in registering space objects of 2007[52],

[52] Adopted as UNGA Resolution n. 62/101 of 2007. Notably, the Chair of COPUOS Working Group on the Status and Application of the five UN Treaties on Outer Space presented in March 2023 a Non-paper called *Revised draft recommendations concerning the submission of registration information on space objects forming part of a satellite constellation* where it elaborated the document of 2007 adding new considerations connected to the current reality of space activities (e.g. addressing the registration of satellite constellations).

the recommendations on national legislation relevant to the peaceful exploration and use of outer space of 2013[53] and the so-called Long Term Sustainability Guidelines of 2019[54]. All of them contain principles that are widely accepted among spacefaring States and that have been translated in the great majority of modern national space laws.

Next to COPUOS, also the International Telecommunications Union (ITU) has pushed for the harmonization of national regulations on orbital and frequency matters. After all, one of its aims is «*to harmonize the actions of nations in the attainment of [the ITU's] ends*»[55].

Thus, the ITU has issued recommendations and other decisions that, although not binding in nature, have received wide implementation at the domestic level, mainly because of the expertise and technicality of the topics touched and because of the importance of complying with them for obtaining and keeping orbital and frequencies allocations. A pertinent act of the ITU that illustrates its role in harmonization is the resolution passed during the World Radiocommunication Conference (WRC) of 2019, which introduced a milestone-based approach for the deployment of non-GSO satellite constellations[56]. This resolution requires that satellite operators meet specific milestones to retain their frequency assignments, thus encouraging the timely and efficient use of the allocated spectrum[57]. States are clearly called to uniformly implement such milestones in their domestic regulations, ensuring the effective use of the radio spectrum by their private space actors.

The second road where the harmonization of space laws is pursued is paved by non-UN international institutions. In the past twenty years, entities composed of governmental and private experts have issued documents aimed at enhancing the coherence of national space laws

[53] *Recommendations on national legislation relevant to the peaceful exploration and use of outer space*, adopted as UNGA Resolution n. 68/74 of 2013.

[54] UN Doc. A/74/20, Annex II, of 2019. COPUOS has adopted also other acts related to national space laws which however, promote or incentivize a general harmonization of domestic measures, rather than setting effective harmonizing provisions. Among them, it is possible to mention the *Recommendations on the application of the concept of the launching State* of 2004.

[55] ITU Convention, Article 4(c).

[56] ITU, Resolution 35-1 (WRC-19), 2019, titled: *A milestone-based approach for the implementation of frequency assignments to space stations in a non-geostationary-satellite system in specific frequency bands and services*.

[57] See M. Hofmann, *Registration of Space Objects*, in International Space Law in the New Space Era (ed. by S. Bhat), Oxford University Press, 2024, p. 139.

worldwide. Among them, it is worth mentioning the Inter-Agency Space Debris Coordination Committee (IADC), an international forum of governmental bodies for the coordination of activities related to orbital debris between thirteen national space agencies[58]. The latter has published in 2002 the first international set of space debris mitigation guidelines (endorsed by the UN General Assembly in 2007[59]), which have become a term of reference in many domestic regulations and have harmonized, for example, the definition of space debris among spacefaring States (N.B. on a voluntary basis)[60].

Another case in point is the publication of the Sofia Guidelines for a Model Law on National Space Legislation of the International Law Association (ILA) in 2012[61]. It contains a template of provisions for the domestic regulation of private space activities, which represents a minimum common denominator for the elaboration of national space laws.

This and all the other examples[62] of international initiatives aimed at harmonizing space laws – either promoted by the UN or by other institutions – have found great success in the international community of spacefaring States.

However, as it was shown in the previous pages, the problem of the fragmentation of space law continues to be present.

The reason is not simply that new issues have emerged, and their regulatory harmonization takes time to be achieved. The main problem is that the results that international harmonizing initiatives produce are the fruits of soft law measures. Thus, they tend to be general and broadly worded, inviting States to adopt practices that have limited effects in practical terms for harmonization purposes. That can be seen, for instance, in the provision harmonizing the list of information on space objects that States are request-

58 For more information see N. Johnson, *Origin of the Inter-Agency Space Debris Coordination Committee*, in ARES Biennial Report 2011-2012 (publ. by NASA), 2014, p. 70.

59 UNGA Resolution n. 62/217 of 2007.

60 *Ibid.*, guideline 3(1): *Space debris are all man made objects including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non functional*. The same definition has been adopted in almost identical terms in every subsequent national law that tackles the problem of debris in orbit.

61 International Law Association, Resolution n. 6/2012 adopted at the 75th ILA Conference on 30 August 2012. See UN Doc. A/AC.105/C.2/2013/CRP.6 for the text with commentary by Prof. Stephan Hobe.

62 Such as the ones put in place by the International Standard Organization (ISO).

ed to share internationally[63] and in the recommendation to introduce insurance requirements and indemnification procedures as a way of seeking recourse from operators or owners of space objects if their liability for damage under the OST has become engaged[64]. Leaving aside their non-mandatory nature, both recommendations are related to basic elements of space regulations and can even appear obvious today. In other terms, they lack incisive inputs for the harmonization of domestic space laws.

There is however a third road to harmonization that has the potential to overcome the issues of international initiatives: the harmonization of space law achieved at the regional level.

Regional Harmonization: The European Road

The most notable and advanced example of regional harmonization is happening in Europe, driven by the two supra-national entities involved in space activities: the European Space Agency (ESA) and the European Union (EU).

The first one uses its tenders and contracts to set uniform standards and requirements for space projects. In other terms, ESA imposes specific technical and operational criteria that must be met by participating entities, ensuring that all Member States and their industries adhere to common standards. A prime example of this is the requirement that ESA's contractors must adopt standards developed by the European Cooperation for Space Standardisation (ECSS), which in turn incorporates by reference ISO Standard 24113 «*Space Systems: Space debris mitigation requirements*»[65]. As a result, ESA's Member States are called to align their national regulations with these harmonized standards, thus promoting consistency among space actors operating with ESA wherever they may be.

As far as the EU is concerned, the normative acts of the European legislator have increasingly strived towards a stronger influence of the EU on its Member States' space legislations.

It is beyond the scope of the present paper to describe the history and legal background of the EU's involvement in matters of space law. Suffice it here to underline the following consideration.

The EU, just like ESA, has used its procurement contracts to set out common standards on how space activities related to the Union

[63] UNGA Resolution n. 62/101 of 2007, point 2.

[64] *Recommendations on national legislation relevant to the peaceful exploration and use of outer space*, UN Doc. A/RES/68/74 of 2013, point 7.

[65] D. Oltrogge, *Space governance in the new space era*, in Journal of Space Safety Engineering, No. 7, 2020, p. 437.

space programs are put in place by its contractors. That is the case, for example, of the requirements on environmental and space sustainability that are mandatory in all European procurements under the Union Secure Connectivity Programme[66].

In addition to common standards for procurement purposes, the EU has also established detailed provisions to ensure the consistent implementation of the EU space programmes across Member States. For example, the Regulation (EU) 2021/696 establishing the Union Space Programme has provided a list of definitions that apply in all Member States for the purpose of the Regulation, such as a legal definition of «space debris» – which is missing at the moment at the international level[67].

Unlike ESA, the EU has also an additional and more impactful power for enhancing a common space framework among its Member States.

As it was stated in the European Union Space Strategy for Security and Defence of 2023: «*Some Member States have put national rules in place to regulate space operations, including security aspects. Without a common framework, these rules may differ. This divergence could affect the competitiveness of the EU space industry and the security of the EU. To ensure a consistent EU-wide approach, and building on the joint communication of an EU Approach for Space Traffic Management*[68]*, the Commission will consider proposing an EU Space Law*» [69].

The EU has not yet adopted such a law, but its publication is expected for the end of 2024[70]. Here lies the power to offer a never-seen-before supra-national intervention aimed at creating a common framework on space activities. With it, the national space legislations of Member States will be called to align their provisions with the provisions established in Brussels in order to avoid fragmentation of the single market for space services and

[66] Regulation (EE) 2023/588 of the European Parliament and of the Council of 15 March 2023 establishing the Union Secure Connectivity Programme for the period 2023-2027, Article 8.

[67] The one in use at the UN level is the product of a technical evaluation put forth by the IADC.

[68] JOIN(2022) 4 final. In the latter, Member States recognized the role that the Commission could play in facilitating coordination of Member States' efforts to address STM legislation and standardization, to foster the convergence of national positions on an EU STM approach.

[69] *European Union Space Strategy for Security and Defence*, JOIN(2023) 9 final, 2023, p. 3.

[70] P. Soler, *Key Commission space law proposal expected in weeks*, published on Euronews.com on 24.5.2024. Available at the following link: https://www.euronews.com/next/2024/05/24/key-commission-space-law-proposal-expected-in-weeks

products, while enhancing the global competitiveness of the EU space industry. The aim is clear: to define and promote common standards for all Member States. Thus, it is foreseeable that the EU Space Law will bring a wave of *de facto* harmonization on national space legislations[71], at least on the key aspects of the resilience, safety, and sustainability of space activities.

What makes this legislative initiative different from all the others described above is the legal value of the provisions contained therein, which are going be mandatory for all Member States, if the «Law» takes the form of a regulation as it is imaginable at the moment. This means that such measures are going to apply to EU-owned assets as well as to Member States' assets – whether public or operated/owned by commercial entities – delivering space services in the EU[72].

Something similar has already been done with Regulation (EU) 2019/452 establishing a framework for the screening of foreign direct investments into the Union[73]. The latter has in fact laid down the essential elements of the Member States' legislations for the screening of foreign direct investments in various sectors, including the space one[74]. With that, national legislators had to adapt their regulatory frameworks and align with the relative Regulation, creating a common legal ground for foreign investments in space companies within the EU.

Interestingly, other regions of the world are taking steps in the same direction of Europe: Latin American and Caribbean States have created in 2021 a regional space agency called ALCE[75]; African States have started to cooperate at the regional level through the African Space Agency and with the adoption by the African Union (AU) of a common Space

[71] Avoiding the exclusion of harmonizing initiatives set out in Article 189 of the Treaty on the Functioning of the European Union (TFEU) by finding a legal basis on other competences of the EU, such as competition.

[72] DG DEFIS' web-page on the open consultation on the EU Space Law, available at the following link: https://defence-industry-space.ec.europa.eu/newsroom/consultations/targeted-consultation-eu-space-law_en

[73] Regulation (EU) 2019/452 of the European Parliament and of the Council of 19 March 2019 establishing a framework for the screening of foreign direct investments into the Union.

[74] *Ibid.* Articles 3 and 4.

[75] See the press release available at the following link: https://www.gob.mx/sre/en/articulos/signing-of-the-convention-establishing-alce-the-latin-american-and-caribbean-space-agency-283235?idiom=en.

Policy[76] as well as a common Space Strategy[77]; in the Asia-Pacific region, two institutions are working towards the creation of common grounds among the States of the region, namely the Asia-Pacific Space Cooperation Organization (APSCO)[78] and the Asia-Pacific Regional Space Agency Forum (APRSAF)[79].

The final result of these efforts is the creation of a regional level of implementation and application of international space law. Some aspects will inevitably remain diversified in the various jurisdictions due to the necessary specificities of each industrial market and of each State's public interests. However, the road paved by the EU, and followed by other regional entities, is increasingly going towards a new level of space law, located between the international and the domestic one: regional space law. And that seems at the moment the best manner to invert the trend of national fragmentation and to promote the development of space law *vis-à-vis* new issues raised by the current reality of space activities.

5. *Concluding remarks*

The past twenty years of deliberation on space law within the international community highlight a significant shift towards national legislation and bilateral agreements, driven by the complexity of achieving

[76] Notably, objective 5 of the AU's Space Policy, titled Coordinating the African Space Arena, reads as follow: «*To regulate space activities. The African space programme will need to be regulated in order to guarantee that strategic objectives are attained. Conflicts of interest will need to be managed to best serve African interests. A regulatory environment will have to be established to allow industrial entities to access space technologies and to promote African commercial private sector participation in the space arena. This regulatory framework will need to be developed and implemented to ensure effective compliance with international treaties and conventions, with the necessary levels of transparency. The African space programme should be compliant with national, continental and broader international laws and regulations*».

[77] AU, *Space Strategy*, 2019.

[78] The Asia-Pacific Space Cooperation Organization (established in 2005 and operational since 2008) is intended to serve the purpose of setting the first brick for a proper regional space law. APSCO inaugurated in February 2024 a new initiative called the APSCO Space Law Alliance (ASLA). Developing regional and international alliance of space law institutions was listed as one of the key strategic areas in the *APSCO Strategy for Space Law and Policy of APSCO (2021-2030)*, which was approved by the APSCO Council in 2020.

[79] The Asia-Pacific Regional Space Agency Forum (APRSAF) was established in 1993 to enhance space activities in the Asia-Pacific region. See the document titled Principles of APRSAF available at the following link: https://www.aprsaf.org/about/pdf/Principles.pdf

consensus on new or amended treaties within COPUOS. This fragmented approach has resulted in diverse and sometimes conflicting national regulations, complicating the legal landscape for space activities and increasing the risk of conflicts. Different countries have individually addressed key issues such as the delimitation of outer space, space resources commercialization, and the conditions for authorizing private space actors.

As the number of these unilateral measures increases, it also underscores the urgent need for a more coordinated international approach to prevent legal fragmentation and ensure the sustainable and peaceful use of outer space.

While efforts at the UN level have led to some harmonization through non-binding guidelines and recommendations, they lack the enforceability to create a cohesive legal framework.

Regional initiatives, particularly within the EU, show promise in setting common standards and regulatory practices that could serve as the basis for a stronger coherence among national regulatory frameworks.

For that reason, the so-called «legislative regionalism» appears today as a privileged forum for international law-making. It is often assumed that international law is or should be developed in a regional context because the relative homogeneity of the interests or outlooks of actors will ensure a more efficient or equitable implementation of the relevant norms[80]. The presence of a coherent cultural community better ensures that the regulations enjoy legitimacy and that they are understood and applied in a coherent way. This is probably the reason why human rights regimes and free trade regimes have always commenced in a regional context, despite the universalist claims of ideas about human rights or commodity markets[81].

A similar path seems to be ahead of international law-making in the field of space activities. And that may just be the key to a new phase in the development of space law.

[80] ILC, *Fragmentation of International Law: Difficulties Arising From the Diversification and Expansion of International Law*, UN Doc. A/CN.4/L.682, 2006, p. 46.
[81] *Ibid.*

Ignazio Castellucci

The Dark Side of the (Space) Law

Summary: 1. The dark side of the law – 2. The existing legal framework for space activities – 3. The Scramble for space, and legal pluralism – 4. A lawscape populated by bubbles – 5. A few *interim* conclusions.

1. *The dark side of the law*

When I refer to 'the dark side of the law', here, I am hinting at a dimension of the law which is seldom focused on, beyond its normally perceived attitude of being an organised set of regulating institutions and statements related to a given area of human activity: I am referring to the 'hidden', or less considered capacity of legal systems and institutions of being a tool of political expansion – with a view to expanding the reach of the 'system's owner', beyond its original jurisdiction, rather than to implement rules within it.

In a general sense, this discourse relates to the law's geo-political nature, and to the need for lawyers, as well as politologists, to deal with geo-legal issues – especially in an area such as space law.

Normative interactions and aggregations amongst different normative systems, of different nature, reproduce geo-political dynamics – including mutual indifference, cooperation, negotiation, competition, conflict, and warfare.[1]

Exploring the space lawscape[2] of nowadays, and much more the one

[1] See I. Castellucci (ed.), monographic issue devoted to 'Geopolitics and the Law' of *Gnosis: Rivista italiana di intelligence*, no. 2/2020, featuring contributions of A. Alì, V. Arpaia, T. Beggio, M. Bussani, M.R. Ferrarese, S. Mancuso, P. Marchetti, U. Mattei, P.G. Monateri, G. Nesi, D. Ragnolini, F. Roggero, F. Ruschi, E. Silveri.

[2] See S. Mancuso, *Lawscapes*, *Int. J. for the Semiotics of Law* (2024), https://doi.org/10.1007/s11196-024-10149-9; in a different meaning, related to Urban Law studies, see N. Graham, *Lawscape: Property, Environment, Law*, London, Routledge, 2011; for a more abstract description, or teoretical modelisation of this notion, see A.

laying before us in the coming decades, it seems clear that geo-legal issues will be at the center of the political action, as well as of scholarly debate.

2. *The existing legal framework for space activities*

It's reasonable to assume that classic international law will not necessarily be applicable at all times in space, not even by analogy: there is a substantial legal vacuum, out there, with the few exceptions of the existing international space covenants, such as the Outer Space Treaty (OST) of 1967.

The existing legal regime based on instruments of 'classic' international space law – as non-state space actors develop activities at a pace unthinkable of, only few decades ago – will increasingly reveal its lacunae, loopholes, and the intrinsic inability to reach non-state or mixed, public-private, subjects, activities, and situations in an increasingly crowded extra-atmospheric space; this inadequacy will show both on the 'passive-protection' side (e.g. on liability for space activities) and in the 'active-regulatory' side (e.g. for travel, exploitation of space and celestial bodies, and related activities) – not to mention the area of 'police', 'security', 'military' activities.

Research is developing beyond classic scholarship on space law[3], still normally focusing on specific aspects of space law (liability, private contracts, national security, etc.) – except for some commendable books collecting research on the various dimensions of space law, trying to present its different aspects and to provide a valuable tool for reflection on the entire matter[4]. However, there still is a distinct feeling and a consensus on the absence of a general legal framework, as well as on the lack of a general legal theory, capable of wrapping-up knowledge on space law at large.

Philippopoulos-Mihailopoulos, *Spatial Justice: Body Lawscape Atmosphere*, London, Routledge, 2014; Id., *In the Lawscape*, in A. Philippopoulos-Mihailopoulos (a cura di), *Law and the City*, London, Routledge, 2007.

[3] P. Jankowitsch, *The background and history of space law*. F. von der Dunk (ed.), 2015, 1-28.

[4] C. Cockell, *The Institutions of Extraterrestrial Liberty*, Oxford University Press, 2022; F. von der Dunk, F. Tronchetti (eds.), *Handbook of Space Law*, Edward Elgar, 2015; P. Achilleas, S. Hobe, *Fifty Years of Space Law/Cinquante ans de droit de l'espace*, Brill, 2020.

3. *The Scramble for space, and legal pluralism*[5]

3.1. Space law and normative environment, or 'lawscape(s)', clearly challenge the 'Westphalian paradigm', and the associated idea of sovereignty of States within given political boundaries – an idea the birth of which is conventionally associated with the Peace of Westphalia of 1648, while its formation in European legal-political thought had started in the previous century[6].

Modern, 'Westphalian' States exercise political, military and legal compression on one another; each of them, defined by its territorial boundaries, features its own jurisdiction and applicable national law as one of the most typical expressions of the State, to display/enforce sovereignty and national identity.

In this conception of law, even European commercial law suffered from domesticisation attempts, if never entirely successful: at the beginning of the 19th century, Fichte theorised the *Geschlossene Handelstaat*, or 'closed commercial state': a water-tight institution in which all plans – political, economic, social, cultural, legal – have identical, overlapping spatial extension corresponding to its boundaries and jurisdiction, dominated by national politics and law.[7]

Rules applicable to relations amongst modern states, meanwhile, have developed to form what is now international law, hailing from early modern European inter-state comity, practices, and treaties – justifying Schmitt's description of it as *ius publicum europaeum*[8] – then expanded in the 19th century to cover the world's inter-national relations.

As a matter of fact, the 20th century has already been characterised by a marked departure from the Westphalian paradigm in trade and economic matters – in a reversed quest, for uniform regulation of transnational economic activities, re-discovering contemporary forms of pre-modern law merchant/*lex mercatoria*, a few decades before globalisation.[9]

[5] This section reflects a discussion already developed in S. Paladini and I. Castellucci, *Sovereign states, private actors, and (national) space laws. A rapidly evolving landscape*, in C. Cockell, *The Institutions of Extraterrestrial Liberty*, Oxford University Press, 2022, 366-383.

[6] J. Bodin, *Les six livres de la Republique*, Paris, 1583, reprint Aalen Scientia, 1977; see it, e.g., at 133: "*Le lois du Prince souverain, ores que'elles fussent fondées en bonnes et vives raisons, neanmoins qu'elles ne dependent que de sa pure et franche volonté*".

[7] G. Fichte, *Der Geschlossene Handelstaat*, Tubingen,1800.

[8] C. Schmitt, *Der Nomos der Erde im Völkerrecht des Jus Publicum Europaeum*, 1950.

[9] See, e.g., F. Rose (ed.), *Lex Mercatoria: Essays on International commercial Law in*

3.2. A non-Westphalian theory may be needed to make sense of current developments of space law.

The present state of affairs in relation to space activities could very much be characterised as a 'scramble for space', or 'space rush', to paraphrase older, well known notions: public and private actors again scramble to set foot on new, mostly unknown spaces in this part of the universe – as European sovereign actors have done in the early modern era with overseas travel and exploration/exploitation, rushing to territorialise somehow those immense unknown spaces, and to reserve and secure its resources; together with private individuals rushing for personal benefit in those newly found, barely mapped, hardly securitised territories.

We might probably look at those (legal) histories to gather suggestions on how the lawscape of travel, settlements and activities on the Moon, Mars – perhaps Jupiter's or Saturn's moons, stretching our foresight very much – would look like[10].

Modern and contemporary developments of medieval transnational business law, and of modern maritime law and international law, especially developed in relation with the high seas, the high skies, Antarctica, could also help in making sense of developments, understanding how the law develops in spaces with no places, including the outer space, celestial bodies, or the digital space. New importance will need to be recognised to multi-shaped or amorphous normative entities, societal roots, legal formants[11], and actual reach of normative forces.

3.3. Ideas and notions that seemed to belong to the past, now gain central stage again, such as those of 'empire', and its relations with that

Honour of Francis Reynolds, Routledge, 2000; O. Toth, *The Lex Mercatoria in Theory and Practice*, Oxford, 2017.

[10] I am not sure the discourse could be stretched any further: extra-Solar system space travel would have, as far as we know, entirely different technical and human implications, related to distance and possible detachment, total and for good, of spacenauts from planet Earth; and/or could be characterised by entirely new themes, such as those related to time-space elasticity, as travel speed gets closer to the speed of light; topic addressed by A. Simmonds, in *Is the Speed of Law Faster than the Speed of Light? Considerations of the Impact of Special Relativity on the Operation of Law in the Context of Deep Space Missions*, paper presented at the Rome Tre University conference on Space Law of 9-10 February 2024; later published as A. Simmonds, *A study of Legal Implications of Time Dilation in Accordance with Einstein's Theory of Special relativity*, in Cambridge Law Review, 9 (2024), 1, 1-27.

[11] R. Sacco, *Legal Formants: A Dynamic Approach to Comparative Law.* 39 American Journal of Comparative Law: Issue 1, Winter 1991, 1-34 (Installment I), and issue 2, Spring 1991, 343-401 (Installment II).

of 'political boundaries' – with the typical relative irrelevance of the latter for the former – and the blurring of lines defining the respective areas of influence amongst different imperial entities, divided by large politically gray, and/or obscillating areas, or 'Rimlands'[12].

A novel interest is also displayed in relation with the notion of 'frontier', rather different from that of 'boundary' – the former having partially been lost after the end of frontiers associated with the full expansion of national states, to cover all of the world's 'places' – with new geo-political frontiers becoming apparent in non-territorial spaces, such as the space or celestial bodies, or the digital space.

The effectiveness of competing legal orders is, thus, the key element to understand such a normative environment, rather than legitimacy and abstract validity of systems, sources and norms.

The 'success' of a normative system in being effective, including vis-à-vis other competing systems in a plural lawscape – its legal power, in other words – is not directly determined by its intrinsic formal contents; nor by the territorial or population size of the political entity expressing it, which may be small, negligible, or plainly non-existent/not relevant: it is, rather, related to the importance of the subjects, and matters, attracted and actually, effectively governed.

This is the case, e.g., with IT global giants and their internal 'normative system', enforceable irrespective and in the absence of any associate state legal system – as the world could witness egregiously in January 2021[13] –; or with present-day small and micro-jurisdictions, able to 'punch above their weight', in finance, shipping, banking, IT services, etc.

3.4. A good idea could thus be, to better grasp possible developments of space law, that of having a glimpse back at the state of affairs before the Westphalian process stated developing.

The pre-modern *ius commune* environment was based on a quite liquid state of legal affairs, with the German Empire and the Catholic Church playing the role of universal powers, and the existence of a vast European normative space with generally acknowledged shared values, enshrined in the body of *ius commune* developed by legal scholars;[14] kings, princes,

[12] A classic *topos* of geo-political literature: see N.J. Spykman, *The Geography of Peace*, Harcourt, Brace & Co., New York, 1944.

[13] When *Twitte*r closed the personal account of President Donald Trump, based on violation of 'Twitter rules' in connection with the Capitol Hill events of Jan. 6-8.

[14] H. Pihlajamaki, M.D. Dubber, M. Godfrey (eds.), *The Oxford Handbook of*

lords, bishops, abbots would also produce their own rules: they would all be intrinsically valid and potentially applicable. Other normative forces, of a public, private or communitarian nature – religious congregations, guilds and chambers of commerce, large business undertakings, local communities of merchants or dwellers, etc. – would also play the game of normative production, whether doctrinal, stipulated, case-based or use-based, in a written or customary form.

Global merchants of those times would develop their own customary *lex mercatoria* through practice, arbitration, compilation of trade usages.

Scope and reach of any given set of norms would be associated to a community and the related interests of its members – according to the dynamics of societies, law, and space identified by George Simmel[15] – rather than to a territory. Members of human communities, on the other side, would normally found themselves subjected to a number of competing normative orders[16].

3.5. A clear vision of this attitude would be visible, more recently, in the reach of European powers' laws over their respective colonial empires and networks of commercial outposts, as well as over their military and commercial fleets reaching all over the world: no Westphalian paradigm would be applied there; each normative system extended its rule, then – in principle unlimitedly, and in practice as far as possible –, subject to the variable effects of power negotiations between competing, oftentimes overlapping, orders and related institutional mechanism.

The description just made seems to be applicable, *mutatis mutandis*, to the present-day global legal environment, frequently referred to as reproducing the dynamics of a 'neo-medieval' model,[17] of which legal pluralism is a typical crucial characteristic, with the existence of multiple normative layers, semi-autonomous vis-à-vis one another[18] – a notion

European Legal History, Oxford, 2018.

[15] G. Simmel, *Soziologie*, Duncker & Humblot, 1908.

[16] H. Pihlajamaki, M.D. Dubber, M. Godfrey (eds.), 2018.

[17] J. Friedrichs, *The Meaning of New Medievalism*. European Journal of International Relations VII (2001) 4, 475-501.

[18] S.F. Moore, *Law and Social Change: The Semi-Autonomous Social Field as an Appropriate Subject of Study*. Law & Society Review, Vol. 7, No. 4 (Summer, 1973), 719; J. Griffiths, *What is Legal Pluralism?* 24 J. Legal Pluralism & Unofficial Law 1 (1986); B. Tamanaha, *Understanding Legal Pluralism: Past to Present, Local to Global*. 30 Sydney Law Review (2008), 375.

evolving into that of today's 'global legal pluralism',[19] in which, again, a high number of normative orders play a game competition, negotiation, mutual cross-infiltration, sometimes hybridisation.

Public and private political, social, and economic geographies produce innumerable complex interactions amongst many different layers, patches, or clusters of normativity, administering institutions, adjudicative and other enforcement mechanisms – according to the individual circumstances of specific transactions or incidents, rather than to a general normative framework coordinating all those different normative systems.

Different normative systems, of different nature, as a matter of fact, do interact freely with state laws and international laws, negotiating their respective areas of influence and effectiveness, based only on their respective *de facto* capacity of seeing their norms (reflecting their nature, agendas, inner mechanisms) attracting operators, and prevail/being enforced in real life and the economy. The already mentioned case of the 'legal system' of a social network being enforced against, arguably, one of the most powerful public institutions in the world, providing an easy and enlightening example of these dynamics.

Dialectics between different normative orders will produce cross-fertilisation and hybridisation of rules, with the most important actors of both public and private nature making more or less stable alliances, cooperating to develop their legal instruments consistently accommodating the needs of both, while competing, cooperating or conflicting with other public-private blocs.

3.6. When dealing legally with the extra-atmospheric space legal environment, 'space' is different from 'place' and/or 'jurisdiction' – the latter normally being associated, in legal terms and in lawyers' parlance, to the felt presence of a territorial sovereign entity, and to the related local 'sources' of law; the former normally lacking the mentioned elements.

Not by accident, initial developments of space law have been conceptualised and implemented in the 20th century as an expansion of classic regulation of the high seas, binding on sovereign states, such as the OST 1967, with rules mimicking that of maritime international law, developed in its modern terms since Grotius.

This process has already taken place with air law, and later with laws regulating other spaces with no places, like Antarctica and the Moon.

[19] F. Snyder, *Governing Globalisation*, in M. Likosky (ed.), *Transnational Legal Process: Globalisation and Power Disparities*, Butterworths, 2002, 65.

Mars, the outer space, or the digital space, could all become new frontiers for this kind of legal developments, including debate or clashes similar to those associated with the legal regime of the high seas – between visions of them as a nobody's space, or everybody's (or the strongest's), and visions of the same as frontiers which may, in some instances at least, be territorialised[20].

3.7. As private actors develop their activities in a legal vacuum, some national states are developing their space laws, with a view to attracting and regulating them, laying the conditions to develop favourable legal eco-systems reflecting their needs, within strategies aiming at somehow territorialising space – i.e. making space a dimension subject to the state's jurisditcion.

This can be achieved, e.g., by exercising jurisdiction on special 'places', 'sites', amounting to 'nodes', hubs, or preferential *loci* associated to the space activities – including their 'grounding' on planet Earth, still necessary for a number of reasons (e.g. people will need to earn, keep, and spend their space-earned money on planet earth, at least in the next few decades; very complex logistics are associated with space activities; and so forth) and purposes (e.g. taxation).

Territorialisation will, thus, be crucial with respect to space ports and their immediate environment and related infrastructure, as it has been, historically, with sea ports, and the with airports[21]; as well as with specific orbits suitable for space activities, space travel lanes, and more or less permanent bases and facilities on celestial bodies – probably amongst the issues which will be regulated with priority, in future international covenants.

Controlling ports, orbits, space lanes, and facilities in the right spots of Earth, space, and celestial bodies, the outer space will become somehow a smaller and manageable *locus*, or a number of *loci*, in a political, economic, and legal sense.

National norms will reflect the different space powers' approaches, both to space and to the law in general – accommodating variable proportions

[20] M. Somos, *Open and Closed Seas: The Grotius-Selden Dialogue at the Heart of Liberal Imperialism*. E. Cavanagh (ed.), Empire and Legal Thought, Brill, 2020, 322-361; M. Somos, *Selden's Mare Clausum: the secularisation of international law and the rise of soft imperialism*. 14 Journal of the History of International Law, 14 (2012). pp. 287-330.

[21] G. Befani, *Usi pubblici del mare e territorializzazione marittima: prospettive geo-giuridiche della pianificazione energetica del mar Mediterraneo*, in *Il diritto dell'economia,* anno 70, n. 114 (2 2024), 59-118.

of political input, state legislation and regulations, mechanisms interfacing them with international law, soft law, other state laws, rules and best practices of the private sector, *lex mercatoria*, etc.

States' objectives will include in many cases, as we are already witnessing with the few national space laws enacted so far (e.g. in US, UK, UAE, Japan, Luxembourg, China) fostering the growth of a nationally-characterised legal, economic, technical eco-system, able to provide a framework for the entire spectrum of activities related to the space industry – from mining, to R&D to space travel and ticketing.

This ability in developing an appropriate, user-friendly normative framework or eco-system – to be balanced with states' capacity to maintain control of sensitive areas and classified information to the extent necessary – will be critical in attracting space economic actors and operators, such as space mining companies, insurance companies, IT service providers, just to mention a few; and, this, both by virtue of internal growth of national space industries, as well as due to flag- and forum shopping phenomena.

State jurisdictions' success in expanding the frontiers of space, and the related space's space economy, will be determined by the amount and 'importance' (whatever this may mean) of space activities regulated, irrespective of the same jurisdictions' 'terrestrial' size – much like the importance of Swiss banking law, of Panamanian maritime law, or of many micro-jurisdictions' tax and financial laws, which have determined those countries' status as major (legal) players in their respective fields, irrespective of their geographic size. Those jurisdictions' relations with others, on the Earth's surface, and capability of interacting with other legal systems to obtain favourable results in enforcing their own law through cooperative jurisdictional mechanisms, e.g. of the kind traditionally found in private international law, will also play a critcal role.

4. *A lawscape populated by bubbles*

In the mentioned state of affairs, it is easy to assert that space activities will be regulated, as they already are, through a number of autonomous or semi-autonomous normative fields[22].

As some states enact space laws, large private actors already sell commercial services regulated by their own rules – which a classic lawyer

[22] S.F. Moore, 1973, *supra* fn. 18

would consider contractual terms under the relevant applicable state law, whether more critical observers would probably characterise as a product of one of those (semi-)autonomous normative fields.

One interesting exercise would be trying and identifying the areas where autonomous normative fields may at some point become semi-autonomous, and eventually integrated or even hybridised with other systems – e.g. state laws and/or other 'laws' of a private origin – or vice versa.

4.1. It seems likely that the initial development of those complex normative environments will take place within the individual sphere of each significant political player in space activities: national states, or very large private actors, developing a coordinated vision, and agendas, with their private subject/allied undertakings – much as it happened in the early modern era with the British *East India Company*, or with the Dutch *Vereenigde Oostindische Compagnie*, and then with the smaller entities associated in business activities with those large companies.

These large players and groupings will operate carrying with them their legal environment, resembling to legal bubbles, both on high seas/deep space, and in ports and facilities reached.

Within those bubbles – made almost exclusively of scientists and military personnel, at least in the initial phase of space travel and colonisation, operating in an unknown, highly securitised environment[23] – developing rule of law will not be a priority, nor will it be a priority to develop a 'space big society' and the related need for a number of fully available civic rights. The priority will be given to fostering the development of space activities, regulating private exploitation of resources, keeping space communities cohese and functional, and attracting as many economic actors as possible within the reach of leading normative systems.

A loose 'rule by law' approach, seems, thus, much more likely, with few general laws, an appropriate amount of public and/or private regulations, and a large number of day-to-day issues dealt with through simple governance and dispute-resolving mechanisms – akin, perhaps, to those historically seen on board oceangoing ships, with the flag law applicable and the more or less absolute authority of the captain[24].

[23] E. Morales, *The law of Mars: The problem of violence mitigation in the development of extraterrestrial political institutions*, in C. Cockell, *The Institutions of Extraterrestrial Liberty*, Oxford University Press, 2022, 254-278.

[24] S.J. Morden, *Anarchy and authority: Summary justice on long-term space missions*, in

4.2. As human communities in space will become more stable, numerous and diversified, a different legal environment may develop, possibly following the dynamics observed, e.g., in late 18th or early 19th century in the British Malayan colony of Penang, when control passed from the *East India Company* to the British Government in the newly formed Straits' Settlement: the lawscape changed, there, if incrementally, from a 'frontier' environment – in a barren island with few settlers, where Company officers would enforce whatever rules they deemed reasonable in the circumstances – to a Company rule regulated by the 1807 Royal Charter, introducing English-style courts judging «according to justice and right»[25]; ending up, eventually, in control over the colony being transfer to a British Governor, and the establishment of a well-structured common law legal environment, if hybridised to some extent, based on the legal principles famously established, for instance, in *Regina v. Willans*[26].

It will also depend, of course, on the relative power between private entities and their 'flag' state, and on the latter's general space policy: large earthly and space powers may display an inclination towards effective forms of public control of space activities, due to their strategic general interest in space governance; while other, perhaps smaller, states and jurisdictions may just have an interest in attracting as many space business undertakings as possible, through a space-friendly, light-burden policy, to benefit from the associated increase in the number of space actors being regulated.

4.3. In addition to top-down international legal covenants, inter-bubble bottom-up-developed legal dynamics , and a 'rule of law' kind of approach will probably develop, initially, in the area of insurance law, tort law in relation to incidents and accidents which may occur; as well as with inter-bubble business transactions, probably regulated in the beginning according to a *law merchant* type of approach – supplemented by the applicable law of the space power able to attract the relevant inter-bubble interaction.

C. Cockell, *The Institutions of Extraterrestrial Liberty*, Oxford University Press, 2022, 279-290, J. Lampkin and R. White, *Space Criminology: Analysing Human Relationships with Outer Space*, Palgrave Macmillan, 2023., esp. Chapters 6 and 7.

25 1807 *Royal Charter*, p. 26.

26 *Regina v Willans* (1858) 3 Ky, 16 ss.; M. Soe, *Principles of Singapore Law*, Singapore, The Institute of Banking and Finance, 2nd ed., 1991, 1-3, 23; I. Castellucci, *Pluralismo giuridico nell'arcipelago malese*, Naples, ESI, 2024.

Transnational law, *lex mercatoria*, Roman Law, the Unidroit Principles, or other meta-systems, even combined, may intervene at that stage, as arbitration/adjudication/ADR institutions also develop their functions, and the associated procedural, and private inter-bubble law mechanisms – similar in their conflict-solving function to those of classic private international law – along with state, supra-national, and other laws and institutional arrangements of a public nature.

While it is difficult to make accurate forecasts, it can safely be stated that space lawscape(s), one or few decade(s) from now, will be characterized by a growing number of national (and EU) space legislations and agencies, increasingly providing legal frameworks, regulation and governance to economic, non-economic, state and dual space activities – such as telecommunications and IT, space mining, space travel, scientific research, etc. – cooperating with those states' private economic champions, and trying to foster their development; as well as seeking to attract foreign ones within their normative eco-systems.

A growing number of private corporations, on the other side, will be developing their own space-related internal rules, and they will be more or less cooperative with those of one state, or one geo-political bloc of states.

International law will most certainly be developed in the meanwhile, providing additional governance at inter-state level.

Normative products of hard and soft law aimed at the private sector will most likely be produced by national and international bodies or agencies, along with contractual instruments and best practices of a private origin.

Private activities, however global or, should we say, beyond global or universal, will still need on-earth-localisation for a long time: to launch vectors, to develop studies, to educate, hire and pay personnel, to localise and regulate space-related contracts; and will not be able to avoid localisation for other purposes, such as tax, administrative, criminal – much like in global finance and its 'landing' jurisdictions.

We may, thus, see space-business-friendly terrestrial jurisdictions become preferred destinations for forum and flag shopping in relation to space activities, with commercial networks and supply chains, providing space-related goods and services, mostly localized in those business-friendly jurisdictions' respective normative eco-systems.

4.4. The sector's expansion will be characterized to some extent by 'frontier', or 'Wild West' logics, with private risk-takers eager to rush for gold, and active national powers playing a police or military role to protect their national interest and that of their private allies in the business.

A very sensitive issue will very soon be, in fact, that of military, security-related, and police activities in the outer space – also considering the possibility of rogue states, or private entities or groups, becoming active in contrasting the interests of other space powers and bubbles – e.g. through piracy; or exploitation of resources, believed to be one's own and somehow happening to be appropriated by others; or through politically motivated attacks of all sorts, including military, or military-tipe, to settlements, ships, and other infrastructure; or hacking/disrupting IT networks, or making space lanes insecure, and so on.

Here, the conflict between different normative orders may become a hot one, mobilising reactions ranging from space police and bubble-law-enforcement, to open war.

One of the few international norms related to the topic of militarisation of space is art. IV of the OST, preventing states from deploying weapons in space, including weapons of mass destruction (WMD).

Clearly, there is a question about defining 'mass': that rule has been thought out long ago, to prevent nuclear or other WMD attacks on planet Earth, staged from the space: would destroying a space ship amount to 'mass destruction'? what about a military action against a space settlement? More generally, how can legitimate retribution be sent in response by those suffering an illegitimate attack? How can police and defense activities in the outer space and on celestial bodies be framed and regulated in international law? All this will be for international lawyers to define in the coming decades.

Meanwhile, it is important perhaps to notice how that almost 60-year-old rule has neve been enforced, so far, nor its enforcement has somehow become a concrete issue. Moreover, in a highly securitised environment such as the imagined one in deep space, this rule seems difficult to enforce, considering the difficulty of carrying out inspections, wheter in space or on the ground, and of accepting them, in consideration of political reasons and to protect classified, or otherwise sensitive, information. It is safe to assume, thus, that in outer space activities in the 21st, and perhaps in the 22nd century, that rule of art. IV of the OST will be deemed not to be applicable, not even by analogy; and that it will, however, remain largely unenforced.

In such a 'wild' environment, states will probably retain full sovereign powers of military and security-related action, policing their own bubbles and reserving the right to defend it from external attacks; with possible similar powers granted to, or self-attributed by, large private actors, and the development, perhaps, of a significant area of hybridity, between military and police activities – e.g. vis-à-vis pirates and other criminal/conflictual actions by space actors.

'Legality' of space communities' activities, vis-à-vis external attacks would be granted by the individual bubbles' legal systems, or by an alliance of several of them – through a combination of covenant, general international and space law, and the individual normative systems expressed by the allied powers in pursuing a given objective; something like what has been seen in the early 21st century in the Indian Ocean, with International, NATO and EU military/police activities aimed at contrasting Somali pirates[27].

5. *A few* interim *conclusions*

Concluding this wild, imaginary space trip, with certainly shaky, and necessarily *interim* conclusions, the scramble for space will produce a high level of legal complexity, with a high number of normative systems playing a very complex game of competition, cooperation, interaction of all sorts, including conflict.

The ability of space actors in developing appropriate institutions and sets of rules will be critical in determining each actor's success in becoming a 'space power' – whatever this may mean.

The appropriate conceptualisation, development, drafting and implementation of the related law, and the political outcomes of the already ongoing 'scramble for space', will thus reveal very clearly the inherent geo-political[28] nature of the law – that of a tool for furthering political entities' long-term visions, strategies and agendas: a 'dark side' of it, seldom appreciated in common jurists' discussions.

The above mentioned possible scenarios will warrant skilled people managing its nerve centres – including lawyers able to assist space main actors and other operators in a complex lawscape featuring several competing normative system, and able to deploy/transfer experience, and

[27] D. Guilfoyle, 2012. *Somali Pirates as Agents of Change in International Law-making and Organisation*, in *Cambridge Journal of International and Comparative Law*, (2012), (1) 3, pp. 81-106.

[28] Another question would be, indeed, the appropriateness, in the context of space-related discourses, of use of the prefix 'geo-': should 'space-politics', or 'urano-politics' replace 'geo-politics?

develop inter-system solutions which are workable in all relevant semi-autonomous, normative fields[29] involved in each individual case.

Discerning, interested state jurisdictions and private space actors will have to develop normative frameworks in constant cooperation and dialogue, endeavouring to promote conversant normative tools, despite diversity, facilitating legal and economic intechange, and maximising the overall functionality and efficiency of the lawscape they will contribute to shape.

Obviously, an opposite tension to securitising and isolating the related issues could characterise the action of space actors not having the development of an integrated, inter-bubble, universal, space economy as a priority.

[29] S.F. Moore, 1973.

Diana Cerini

Two Sides of the Same Coin: Insurance for Space Activities and Space Activities for Insurers

Summary: 1. Space ventures: insurance as an essential partner – 2. A *niche* market for important and highly specialized players – 3. Insurers as risk takers: from "traditional" space risks to new perspectives – 4. Insurers as Investors – 5. Space for Insurers – 6. Space, insurance and sustainability issues.

1. *Space ventures: insurance as an essential partner*[1]

Humans have always looked at the stars and Space. For centuries, the place of the Divine and the unknown have been observed with respect, curiosity and sometimes a little fear.

From admiration and observation, the interest has then moved on to exploration, answering to the inherent human need to discover. Space ventures have consequently taken a different path, especially after World War II, and as a pure product of the Cold War. The first exploration flights in the 1950s and 1960s were, in fact, part of an extreme race between the two great powers of the time (USA and URSS) to conquer the Space.

This was just the beginning: from the 1970s onward, military and security ventures started to be paired with other goals of space activities. The Space, which was and still is considered mainly a resource for research, state security and other public goals, has gradually acquired a commercial relevance, especially with the advent of telecommunication technologies (telephony, television, internet), followed by geo-observation, geo-navigation and other innovative tools. From that sphere, conceived

[1] The paper mainly translates in writing the speech given at Roma Tre University Conference "*Comparative visions in space law*", 9-10 February 2024 (last draft revision at April 2024); further analysis and full notes and quotes of authors and sources, with reference to data and comments presented in this paper, can be found in D. Cerini, *Rischi, responsabilità e assicurazioni per le intelligenze artificiali*, Milano, 2024, in particular Chapter VI, where space risks in connection to AI applications are considered in details.

purely to accompany the activities of space utilization, more and more extensively the space venture has since been directed toward "on earth" uses, that is, for projects related to everyday's human life on the Planet.

The idea of an emerging *space economy* started to be fully analysed and discussed by different players. According to the OECD, the Space Economy "*is the full range of activities and use of resources that create value and benefits for humans in the course of exploring, researching, understanding, managing and using space*"[2]. What Space Economy is concerned with, however, is not only about the Space in the narrow sense. More specifically, Space Economy regards other fields where space activities can have a role, such as digital, agriculture, and energy applied. The Space Economy (SE) or Space-based Economy is actually intended as the production and financial sector oriented toward the creation and use of goods and services and the exploitation of resources in the realm of outer space. Hence, also the increasingly significant relationships with technological innovation and satellite control, most recently in relation to forms of use of artificial intelligence systems, pushed the research as well as the applications[3].

Nevertheless, space ventures have always been, and still are, highly risky. There is, in fact, a full range of perils connected to space launches, in orbit space activities and services agreements, as well as to the functioning of satellites and the multiple uses of the Space. Insurers have supported those involved in pioneering missions and activities since the beginning. This is not surprising: the history of insurance shows that insurers have step by step enlarged their field of action where it was necessary to transfer and professionally manage the inherent risks of human life and activities[4], here

[2] OECD, *Space economy investment trends: OECD insights for attracting high-quality funding*, *OECD Science, Technology and Industry Policy Papers*, No. 166, OECD Publishing, Paris, 2024.https://doi.org/10.1787/9ae9a28d-en.

[3] K. Muti, O. Credi, G. La Rocca, *Il sistema-Paese Italia di fronte alle sfide dello spazio: tra space economy, cooperazioni internazionali e cybersecurity, ed. Istituto Affari Internazionali,* 2023, SSN 2280-6164.

[4] See A. La Torre, *L'assicurazione nella storia delle idee: l'assicurazione come risposta giuridica al bisogno economica di sicurezza: ieri e oggi,* II ed., Milan, 2000; G. Fanelli, *Le assicurazioni*, in *Trattato di diritto civile e commerciale*, a cura di A. Cicu, F. Messineo, vol. XXXVI, Milan, 1973, pp. 65-136; B. Caizzi, *Assicurazione ed economia nell'età moderna*, in AA. VV., *L'assicurazione in Italia fino all'unità*, Milan, 1975; M. Albert, *Le role* économique *et social de l'assurance*, in F. Ewald and J.H. Lorenzi (eds.), *Encyclopédie de l'assurance* (Paris, 1998), pp. 18–24; M. Clarke, *Policies and perceptions of insurance* (Cambridge University Press, 2005); see also the summary by H. Heiss, *Insurance Contract Law Between Business Law and Consumer Protection*, in *General Reports of the XVIIIth Congress of the International Academy of Comparative*

included those connected to the Space.

The role of insurance companies was not an easy task: they were called to play in an innovative environment, where many traditional technical rules of insurance – *i.e.* actuarial models – as well as legal rules developed in codes or international (insurance) uses were inapplicable or practically useless. No surprise that, at the time of the first demands of insurance for space activities, the answer of many was in terms of uninsurability[5] because of the "unknown and unforeseeable", in physical terms but also for the lack and uncertainty of legislation and rules to apply (which remains partly true even today).

Nevertheless, the initial scepticism was soon abandoned and the insurance market quickly reacted with increasing proposals[6]. Space coverages were initially offered within the branch of aviation insurance, which at its turn was a branch of transport insurance. Once the specific aspects of the space business became clearer, as well as the need for topic solutions to address space risks[7], Italian companies pioneered the offer with *ad hoc* and tailor-made solutions: Assicurazioni Generali issued the first pre-launch policy for Early Bird (1965), followed - a few years later - by the coverage for the launch phase of Intelsat III (1968)[8]. Loyd's then

Law/Rapports Généraux du XVIIIème Congrès de l'Académie Internationale de Droit Comparé (2011).

[5] Let us remind that an uninsurable risk is a condition that poses an unknowable, unmeasureable or unacceptable risk of loss or a situation in which the insurance would be against the law. Unmeasurable risk or extremely high risks can require different techniques of coverage, especially in terms of public-private partnership (PPP). An uninsurable risk, on the contrary, cannot be insured at no condition: it may for example refer to a situation in which insurance is against the law, such as coverage for criminal penalties: this rule is applied in the majority of the jurisdictions. See R.E. Keeton, A.I. Widiss, *Insurance Law*, West Publishing, 1988, p. 10 ff; G. Raussera, E. Choia, A. Bayen, *Public–private partnerships in fostering outer space innovations*, PNAS, October 16, 2023.

[6] P.S. Dempsey, *National laws governing commercial space activities: Legislation, Regulation and Enforcement*, 36, Nw. J. Int. L & Bus., 2016.

[7] As early as the mid-1920s, Generali was dealing with the first aviation coverages, and by the early 1930s a full-fledged aviation branch was in operation. As a first insurance judicial case with global relevance see *Appalachian Insurance v. McDonnel*, 1989. See B. Pagnanelli, *L'assicurazione dei rischi spaziali*, in *Assicurazioni*, 1980, pp. 383 ff.

[8] K. Malinowska, *Space Insurance: International Legal Aspects: International Legal Aspects*, Wolters Kluwer, Aerospace and policy series, 2017, pp. 153 ff.; P. Blassel, *Space Projects and the Coverage of Associated Risks*, *Geneva Paper Risk Insuruance Issues,* 10, 51–83 (1985). https://doi.org/10.1057/gpp.1985.8; I. Kuskuvelis, *The space risk and commercial space insurance,* Space Policy, Vol.9/2, May 1993, pp. 109-120.

followed, together with other selected companies. In 1975 the coverages were extended to other risks, from the signature of the contract to the end of life of the satellite. In 1977 Sirio venture was insured with a structured package of coverages. 1977 is also the year of the first event of damage related to the destruction of Thor-Delta and the loss of the OTS1 satellite[9].

The transformation of the space missions from an occasional activity into a more and more complex industry and business also increased the offer of insurance and their strategic role. The appearance of private players and stakeholders has also modified not only the market but the strategies and needs of coverage.

There is no time here to fully explore the history of space insurance. Nonetheless, if one should describe the business today, it could be identified as "*a highly specialized niche market into which fall all contracts of insurance designed for protecting against the financial consequences of losses occurring before, during and after the launch of an artificial satellite*"[10]. The frontier is today identified with the need for more and more wide comprehensive coverages for commercial space economy, as well as the challenge to approach satellite risks combined with artificial intelligence solutions, also in relation to "on Earth" application, such as those connected to smart mobility and IoT (Internet of Things). The role of insurers is consequently set on multiple scenarios, also in connection with different risks and liabilities in question.

2. *A* niche *market for important and highly specialized players*

The reasons for the connection among space activities and insurance are numerous and mainly related to the crucial role of insurers in accompanying and supporting the space ventures:

(i) the first reason relates to the role of insurers as *risk takers* allowing companies to enter the market and, at the same time, to provide protection of potential damaged parties (states and other entities

[9] B. Pagnanelli, L'*assicurazione per le industrie e gli enti spaziali,* in *L'Italia l'Europa lo Spazio*, in *Evoluzione tencologica e attività spaziale negli anni Ottanta*, Atti convegno di Trieste 5/6 aprile 1979, pp. 227 ff.

[10] This is a descriptive and operational definition, as proposed by AON, *Insuring space activities*, Report, October 2016. For an in-depth analysis see again Malinowska, *Space Insurance, quoted,* p.101 ff.; OECD (2011), *Insurance market for space activities*, in *The Space Economy at a Glance* 2011, OECD Publishing, Paris.

and parties). Private investors - whether banking institutions, other companies, or venture capital funds - value the concept of risk carefully. Clearly, the main tool for risk transfer is insurance.

(ii) the second reason refers to the role of insurance companies as investors in the business, both with their own (limited) resources (direct investment) and with money collected by clients' fees (indirect investments) with life insurance contracts, then connected to funds;

(iii) in addition, insurers are more and more essential for realising risk prevention activities; this is a core part of the business, where teams of experts with different skills are required. Insurance space contracts, obviously, are all tailor-made in the business and this facilitates the research for the best strategies in the direction to prevent damages in synergy with insured clients.

It is true, nevertheless, that the segment of space insurance remains quite peculiar and it is performed by a small number of companies: despite its Italian roots, the space insurance market is actually a global one where national players have a limited role. Even if the situation could soon change, also in line with the efforts by the Italian Association of Insurers (ANIA) to strengthen the dialogue with companies[11], in the light of the renovated interest for the market also as a consequence of the new law on space activities, the *niche* approach to space risks is actually due to many reasons, some of which one can just briefly recall:

(1) *magnitude* of the risks involved often qualified as catastrophic risk. In addition, for a long time, very few actuarial data have been available, and that has made it very difficult to set correct parameters for premiums;

(2) *legal uncertainty* is another element which characterizes the space insurance business more than others: this is due to a double side factor: *(a)* one coincides with difficulties to clearly identify relevant rules in space law, especially where liability issues are involved. Different level of provisions may apply, starting from supranational rules and convention, EU laws (under art.189 TFEU), and - because of the atypical shared competence – even national rules[12]. Unlike air

[11] See the numerous papers on the topic in Marine Aviation & Transport Insurance Review, in particular July 2023 – n. 2/XIII.

[12] For example, for the Gmes-Copernicus projects, but also Galileo, Egnos. In some states the law requires mandatory insurance, in other states it is the licence release that is submitted to insurance and financial guarantees (ex. Sweden, Norway, Canada). Also see

transport, where the International Civil Aviation Organization (ICAO) is responsible for air safety, space flight safety issues are still dealt with by the government agencies of individual states. However, increasing cooperation between space powers, the emergence of new players (India, Brazil, China) and the appearance of private space tourism operators have led the international community to reflect on the need to reform and harmonize the existing legal framework and adapt it to the new context. The mission of the International Association for Space Safety (IAASS) Conference is to implement this reform; *(b)* In addition to this inherent level of legal uncertainty on space law, one should add the fact that insurance for space risks is dealt with by insurance and reinsurance treaties on a global ground, as well as with solutions that imply supranational approach to the cover. All these elements generate a situation of uncertainty, related to the rules that are to be applied to insurance, which in many cases remain submitted and governed by national rules[13];

(3) *intersection among public and private goals, and entities* involved. This peculiarity raises the necessity of a strong dialogue among private players (insurers and private entities involved) and the states. Strategies to cover these risks had to develop as a combination of private and public tools. In fact, the presence and role of States as partner was and still is necessary whereas the risks remain too big or atypical to be covered without a public framework. Even today, some of the above-mentioned space risks are traditionally dealt with in combination between the States and private actors. Some other risks are to be considered within the boundaries of private law negotiations. On one hand, it is true that private entities are better equipped to offer coverage for risks that can be qualified as "normal" as well as for risks connected to catastrophic events, here included those that are extraordinary relevant in magnitude because of the number of subjects/chattels involved or because of the magnitude of the single insured event; on the other hand, however,

Malinowska, *Space Insurance*, *quoted*, here at p. 132.

[13] See for the problem of harmonization of insurance law H. Heiss, *From contract certainty to legal certainty for reinsurance transactions: the Principles of Reinsurance Contract Law (PRICL)*, in *Scandinavian Studies in Law*, vol. 64 (2018), pp. 92–114, especially at § III. On the idea of optional laws and restatements to be used in commercial contracts, see M. Fontaine, *Les principes pour les contracts commerciaux internationaux* élaborés *par UNIDROIT, in Revue de droit international et de droit comparé*, 1991, p. 25 ff; M. J. Bonell, *An international restatement of contract law. The UNIDROIT Principles of International Commercial Contracts*, III ed., 2005, p. 9 ff.

there is anyway the need of a public-private partnerships. This liability, despite the regulatory uncertainty already more widely reported, is governed by a series of international conventions, beginning with the 1967 Treaty on Norms for the Exploration and Utilization by States of Outer Space, Including the Moon and Other Celestial Bodies (see Article VII); followed by the more specific 1972 Convention on International Liability for Damage Caused by Space Objects[14].
In relation to damages from falling space objects, states that authorize a private company to operate in space would grant a license, making it also subject to financial assessments and, above all, requiring that an insurance policy has to be taken out, with ceilings varying from state to state, in order to cover any damage caused to third parties. And for the not unlikely event of damage exceeding the insurance limits, each state would remain guarantor of the coverage of the residual compensation to the injured, according to a scheme, once again, of strict liability on the part of the (launching) state[15].
That leaves, in short, the deep pocket of the public treasury to guarantee full reparation of damages suffered by third parties. However, such a solution, while rational and "proven" in the space sector, when applied to cyber-satellite damages related to smart mobility, could clash with the current, pregnant needs of public spending restraint, which are certainly more politically-legally felt than in the 1970s, the time when the liability architecture briefly described here was designed[16];

[14] The premise of that Convention recognizes the primary legal need to provide full compensation to accident victims. Therein, in fact, the Contracting Parties recognize, among other things, "*the need to develop efficient international procedural rules concerning liability for damage caused by space objects, as well as, in particular, to ensure the timely payment, in accordance with this Convention, of full and fair compensation to the victims of the said damage*".

[15] V. Spada, *Responsabilità per danni da oggetti spaziali*, in M. Deiana (a cura di), *Diritto della navigazione*, pp. 359 ff.; see also art. II of the Convention on International Liability for Damage Caused by Space Objects (1972) proclaiming emphatically that: "*A launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the earth or to aircraft flight"*; and, as per Article III, "*In the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State, the latter shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible*".

[16] See, with reference to the Italian landscape, art. 81 of the Italian Constitution on the Principles of financial balance. For this and other analysis of the topic, see A. Pisani Tedesco, *Smart roads*, in D. Cerini, A. Pisani, *Smart roads e smart cars: prospettive e problematiche in tema di responsabilità ed assicurazioni,* Milano, 2018, pp. 95-97. In

(4) at the same time, *insurers are essential facilitators and silent regulators.* It is inherent to insurance business to have a social role in facilitating activities or allowing activities that would otherwise be abandoned, because private parties cannot face certain type of risks without a financial coverage. At the same time, the presence of an insurance apt to undertake the risk (or part of the risk) allows those involved in the business to get the necessary credit from other financial institutions. This also implies that insurers are in the position to ask compliance to specific duties to avoid moral hazard and to prevent damages, having in that the role of silent regulators.
This clarified, if one looks at the "insurance" side, different forms and insurance solutions can be relevant, going from the study of specific insurance programs at an international level to more peculiar aspects of insurance contract law directly connected to the specific coverage in place, *i.e.* with reference to non-life (or damage) insurance (that is the case for the multiple solutions of liability insurance involved as well as other liability insurances for damages) and/or life insurances for people who could be damaged.

3. *Insurers as risk takers: from "traditional" space risks to new perspectives*

3.1. *Insurance companies as risk takers in space activities: traditional risks*

If we consider the "traditional" space risks, insurance companies generally offer coverages for the four essential phases of most satellite projects, working before or during the launch, as well as for the after-launch phase:

(a) in the pre-launching phase, insurance covers risks connected to construction and manufacturing, transport of the tool and preparing of the launch. In this phase the policyholder and insured party is generally the manufacturer;

(b) the launching of the satellite requires a specific tailored-made coverage. This is statistically the most dangerous and risky activity. Insured parties can be the manufacturer as well as the owner;

(c) policies sometimes also isolate the activity of positioning the satellite, as

the same book see also, D. Cerini, *Tra c.d. "smart roads" e "smart vehicles": prospettive e problematiche in tema di responsabilità ed assicurazioni*, pp. 3 ff.

a specific coverage requiring *ad hoc* provisions;

(d) operating of the satellites in orbit and in life coverage of the satellite. A number of subjects can have an interest in insurance. Generally, this phase is covered with two formulas: the so-called "coverage for launch + 1 year" or the "in orbit coverage". The latter formula has to be submitted to annual renewal and is generally optioned by the satellite operator.

All the risks are here managed taking into consideration tailored-made solutions and often combining different lines of policies. For example, direct insurance, that is to say insurance for damages suffered by the insured party, as well as liability insurance can be combined with each other. A loss of income coverage is more important, even if this type of risk remains very difficult to set.

Let's also specify that in-orbit insurance offers protection against the risk of a satellite's complete or partial failure during the operating phase. As with launch insurance, the insured value is an agreed value, which at the beginning of the satellite's service life is based on the replacement value. The sum can cover up to the whole value of a satellite. Physical destruction or complete inoperability result in a total loss, while a partial loss or a constructive total loss result if the performance or service life of the satellite is only partially impaired.

The functioning of this policies might be complex and requires high expertise as well as the combination of different and subsequent coordinated contracts.

3.2. *New perspectives connected to on Earth use and commercial activities*

One can mention some new areas of interests and new challenges for insurers.

First of all, it is important to recall the sector of the so-called space touristic activities (another example of "extreme tourism", an expression that is also used with reference to the scenario of deep blue marine ventures, where similar problems are faced by insurers). The main risks involved refer to life and other personal damages for "clients" (space tourists) as well as to liability issues of the operators.

Other risks are now more and more relevant and considered by insurance, especially with reference to the consequences of negative events in "on Earth" activities implying the use of satellites and space utilities. The need for insurance is increasing in tandem with the commercialisation of earth exploration. For example, the number of images and the image quality from these satellites are usually insured. The insurance of satellites with complex and new types of payloads is where the know-how and experience of aerospace experts really pays off. The deployment of previously untried satellites always raises questions about their insurability. A lot of hard work and dedication is required during all the phases. Manufacturer's technical specifications and presentations, discussions with the manufacturer, operator and broker all need to be analysed before the pieces of the puzzle can be assembled into a well-designed coverage concept. Just as example, one can mention strategies to cover risks connected to autonomous vehicles and other activities of geolocalisation for marine applications.

Even in this case, loss of income coverages become extremely important, relying on the study of the very technical characteristics of insured event.[17]

In many cases, the intersection with cyber risks and cybersecurity, as well as the managing of the relevant risks, are also to be considered (*i.e.* malfunctioning of satellite having a direct impact on a number of activities on Earth).

3.3 *"Old" problems and possible new strategies for insurers*

The more space activities evolve, the more new solutions and strategies are required in order to face inherent problems. Just to mentions some of the critical areas, one can refer to:

a) the dramatic *ratio* among premiums collected and compensation due, which remains in many cases not really profitable for companies[18];
b) high congestion, with higher risks of collisions and interactions ("satellite pollution" related events)[19];
c) the need to coordinate insurance coverages with other risk management tools, considering in particular the connections with cybersecurity

[17] This can relate to different aspects, i.e. the distinction among one or more insured events in case of multiple interruption of signals.

[18] See comments and notes by B. Pagnanelli, *Space threats and satellite business: the role of insurance,* in *Space threats and critical infrastructure, risk and counter measures*, SPARC Workshop, January 2014, Rome; OECD (2011), "Insurance market for space activities", in *The Space Economy at a Glance* 2011, OECD Publishing, Paris. One should remember, just as an example, that a single insured event in autumn 2023 (the Viasat3 claim) absorbed 80% of the collected premiums in the year (in fact, 420 million dollars were paid!).

[19] See comments by P. Martin, A. Viola, 30 November 2017.

issues related to satellite applications[20];

d) these practical criticalities combine with the said difficulty in identifying legal rules referred also to new risks (just think about the absolute mess in regulating AI systems, which the forthcoming Artificial Intelligent Act by the EU law does not seem to solve in any way, postponing liability and insurance issues to further regulations)[21].

The main worry is consequently the scarce possibility to find proper forms of coverages. Reports tell us that big insurance names are abandoning the market; other companies have restricted the offer of some types of coverages; only a few others seem to emerge covering very specific risks or in connection to captive model. With regard to the latter category, we can actually count less than 30 underwriters all over the world.

Analysis and experts have tried to suggest solutions and to identify proactive measures for the future. Not having the competence to fully evaluate the position of economic players from a strategic point of view, according to the analysed data I can summarize some ideas in order to assess what the space insurance market consequently seems to require: (a) joints ventures and stronger interactions among insurers and experts; (b) increase of preventive joint activities; (c) new distribution models especially for small satellites (for example in form of collective insurance that is to say insurance contracts covering multiple insured parties or multiple operations): this last point seem to be extremely important if one read it in connection to the more and more frequent introduction of compulsory insurance models, in order to aggregate more similar risks and avoid inefficiencies connected to moral hazard on the side of the insured parties. At the end of the day, like any other form of compulsory insurance, this could result in a better protection of potential victims of damages.

The idea for a compulsory insurance has been also analysed within the proposal for an Italian legislation, discussed on the 20th of June by the Italian Council of Ministers, in which art. 9 expressly refers to the combination of insurance and banking guarantees for space activities. In

[20] M. Scholl, T. Suloway, *Introduction to Cybersecurity for Commercial Satellite Operations (2nd Draft)*, National Institute of Standards and Technology, 25 February 2022, https:// csrc.nist.gov/publications/detail/nistir/8270/draft.

[21] See P. Holliger, Space needs a sustainable insurance industry: "*Adding to insurers' concerns is the complexity of business models in the most commercially dynamic region of space, low earth orbit; growing congestion in certain orbits; and a lack of international rules to govern this new use of space*, in https://www.ft.com/content/d93f6044-73fd-41fe-a2e5-a57becc26eea.

particular, without going now into details, one should at least remember that the Italian proposal of law provides that licensed operators must take out insurance contracts to cover damages resulting from space activities with a ceiling of 100 million per event[22].

It is clear that the introduction of a mandatory form of insurance requires the possibility of the market to absorb it, even with the study of guarantee funds and PPPs (public private partnerships).

4. *Insurers as investors*

Insurance companies are, likewise, major institutional investors in the national and global arena. In this capacity they can facilitate investments (even in line with sustainability goals) through the use of their own resources, as well as through the placement of capital raised in the form of premiums collected in the distribution of life insurance products or capitalization contracts. Projects are on the table with reference to space activities.

In their role of investors, also in connection with the retail investment strategy adopted by the EU[23], insurers can direct invest to companies

[22] Art. 9 is in line with the traditional "legal" model that provides the option among banking and insurance guarantees, whereas only insurers can offer both financial guarantees and real coverages in terms of liability so to protect not only third parties or creditors but also the assets of the liable party. This provision demands, among other things, a licensing requirement for space activities and provides for a Supervisory Authority, a Registry of Registration of Space Objects Launched Outside the Atmosphere, a National Plan for the Space Economy, and economic measures. See for comments P. Iaboni, *A brief outlook on the announced comprehensive national law regulating space activities in Italy*, IBA Letters, 14.3.2023, at *www.A brief outlook on the announced comprehensive national law regulating space activities in Italy | International Bar Association (ibanet.org)*. Let us also remember that in April 2022, a distinguished working group formed by the Leonardo Foundation - Civilization of Machines, the Space Economy Evolution (SEE) Lab of SDA Bocconi School of Management and the Sapienza University of Rome that set up working tables aimed at supporting the drafting of an Italian law on space. The proposal of law, the text of which is not fully disclosed, should take into consideration at least some of the recommendations expressed by the recalled working group. The text of the report on the Leonardo Foundation et alia's draft can be read at www.Presentazione standard di PowerPoint (fondazioneleonardo.com).

[23] The importance of retailers and consumers' approaches to investments, thus linked to the users of financial and insurance services, consistent with sustainability goals has led Europe to develop a true retail investment strategy: this term refers to a set of actions and rules that Europe intends to put in place in order to enable retail investors to make decisions in line with their needs and preferences, ensuring comparability

involved in space activities that are mainly in line with social and environmental sustainability issues.

5. *Space for insurers*

As well as insurers are crucial to develop space activities, the Space can give back to the insurance business in terms of potential applications of space-based solution to the business. In times of increased awareness for climate change and consumers' demands for digitalisation of many services, the insurance sector can now more than ever benefits from space-enabled services and applications. In fact, one can mention the role of space activities in relation to a number of Insurtech applications. Technologies such as Geospatial Intelligence, Geopositional Systems (GPS), and the Internet of Things (IoT) have a significant impact on the insurance industry. The space technology industry has helped spur yet critical innovations in the sector[24].

In very short terms, one should remember that space uses within the managing of insurance and services and company governance may be related to a quite varied portfolio of activities, among them: (*a*) collecting information and imaging, especially for the functioning of parametric

between products, fair treatment and due protection of investors'rights and in the same time in order to promote sustainability choices: all this is in line with the European Commission's goal of creating "*an economy at the service of people*".

[24] According to what is reported by expert websites, geospatial intelligence refers to the systems which derive information from Earth images to provide context and insights from both a human-centred and environment-centred perspective. These technologies are frequently provided by satellite imaging, and can be used to analyse and predict weather risk, counter fraudulent claims, and even redefine traditional insurance models (e.g., parametric insurance). GPS technologies provide information about the location and timing of certain events on earth. Insurance companies can leverage GPS to establish risk zones for various climate phenomena, provide data on the speed of an insured automobile, and locate insured cargo. Finally, IoT technology involves any device which can connect and transmit information via the cloud. IoT technologies are critical for the digitalization of the InsurTech sector and vastly improve customer experience with insurance. In fact legacy insurance systems are seeking to take advantage of these technologies before they are edged out by younger insurtech competitors. *See* EIOPA, *Report on the digitalisation of the European insurance sector*, EIOPA-BoS-24/139 30 April 2024, in particular p.46-49; K.U. Schanz, *The value of insurance in a changing risk landscape*, Geneva Association Papers, 2023.

insurances[25]; (*b*) claim managing[26]; (*c*) actuarial analysis, that could benefit from the use of advanced analytics, the company is able to provide more affordable insurance and reinsurance policies; (*d*) prevention of bad events[27]. This last element leads us to the theme of sustainability.

6. Space, insurance and sustainability issues

The issue of sustainability immediately comes to mind with reference to insurance[28].

Numerous aspects are involved. Among them:

(a) If we consider insurers as risk takers, insurance companies are relevant in offering solutions to accompany virtuous players and promoting ethical and sustainable behaviours.

[25] Insurance companies and claim management agencies can use space services for collecting big data by satellite or drones, simplifying the use of parametric insurances. See *Libro Verde sull'assicurazione contro le calamità naturali e antropogeniche (Commissione Europea, 16 aprile 2013) – Risposte ANIA alle domande,* in *Contratto e impresa/Europa,* 2013/2. CCRIF/SWISS RE, *Excess Rainfall Product, A Guide to Understanding*, 2012 (www.ccrif.org); SWISS RE, *Weathering climate change: Insurance solutions for more resilient communities,* 2010, p. 10 ss; A. Monti, *Multi country pooling schemes for the financing and transfer of climate-related disaster risk – A comparative overview,* in Environmental Loss and Damage in a Comparative Law Perspective, edited by B. Pozzo, V. Jacometti, INTERSENTIA, Cambridge, 2021, pp. 455-465.

[26] Under this model, a policyholder would receive an immediate payment of a pre-specified amount as soon as a *trigger event* covered by the insurance policy occurs. This model is particularly promising because it removes the human element from claims management, which decreases the time a policyholder has to wait for payment and removes the possibility of a fraudulent claim: see https://www.spacecapital.com/publications/role-of-space-economy-in-insurtech

[27] Flooding and other catastrophic natural risk can be better foreseen thanks to the use of information obtained by the Space and satellite activities. Furthermore, due to climate change and other environmental factors, historical data alone are not sufficient to build highly accurate predictive models.

[28] *UNEP FI, Nature-Positive Insurance: Evolving Thinking and Practices, 2023, at www.Nature-Positive-Insurance-Briefing-Paper.pdf (unepfi.org); AA. VV.,* Managing *environmental, social and governance risks in life and health insurance business' The firs ESG guide for theglobal life and health insurance industry developed by UN Environment Programme's Principles for Sustainable Insurance Initiative, UN environment programme, giugno 2022 https://www.unepfi.org/wordpress/wp-content/uploads/2022/06/PSI-Life-Health-ESG-Guide.pdf.;* D. Cerini, *From "green" to "blue": l'assicurazione tra sostenibilità e regole del mercato,* in *Assicurazioni*, 2022, pp. 9-46.

One of the main areas of interest concerns their role in the coverage of specific aspects: for example, managing of debris risks[29].

(b) Their role is also relevant with reference to the already mentioned prevention activities as they have a crucial role in the dimension of environment and social sustainability.

(c) One such sector that has seen tremendous growth and investment refers to the marine and maritime industries, where the application of space-related tools can help a better management and reduction of risks with beneficial effect in terms of protection of big waters and coastal population[30]. This is a relevant field that might be better analysed, also in

[29] See for example solutions exposed in the *Consultation on Orbital Liabilities, Insurance, Charging and Space Sustainability*, by the UK Space Agency, 14.11.2023, available at https://www.gov.uk/government/consultations/consultation-on-orbital-liabilities-insurance-charging-and-space-sustainability; see also International Organization for Standardization (2014), ISO standard 16126:2014: *Space systems – Assessment of survivability of unmanned spacecraft against space debris and meteoroid impacts to ensure successful postmission disposal*, ISO/TC 20/SC 14, March, www.iso.org.

[30] Some examples include application by global operating companies, such as - among others - ScootScience and Paxafe. Scootscience is an underwriting firm whose goal is to “make oceans insurable.” As far as extreme temperature changes year over year, as well as variations in salinity, oxygen levels, algae blooms, and plankton concentrations can lead to extreme losses to the aquaculture (fish farming) industry, ScootScience uses satellite and IoT data to allow fish farmers to choose the amount of protections they wish to receive in the event of a loss due to environmental changes. PAXAFE is a logistics insurance company focused on cargo as it traverses the oceans, rails, and roads to reach its final destination. In the past decade, cargo insurers have paid out more in claims than they have collected in premiums due to poor risk models and failure to track assets in real-time. PAXAFE has two products called Track-x and Sens-x which measure humidity, temperature, impact, light, and can track real-time asset location. These products send alerts to the user’s phone or computer about potential threats to shipments. With a core competency in sourcing and evaluating early-stage investment opportunities, Space Capital ensures a diverse and profitable portfolio of the most promising, cutting-edge companies developing space technology that makes a big impact in the world. At the forefront of innovation in the space technology, industry and economy, these companies have an enormous potential for growth. See AXA, *Ocean Risk and the Insurance Industry*, May 2018, spec. pp. 25 ff.. ; Swiss Re, *Insurance for the blue economy Risk solutions for ocean and freshwater sustainable development: a China perspective*, 2023, 2023-06-sri-insurance-for-blue-economy.pdf (swissre.com); World Bank, “*although the term “blue economy” has been used in different ways, it is understood here as comprising the range of economic sectors and related policies that together determine whether the use of oceanic resources is sustainable. An important challenge of the blue economy is thus to understand and better manage the many aspects of oceanic sustainability, ranging from sustainable fisheries to ecosystem health to pollution. A second significant issue is the realization that the sustainable management of ocean resources requires collaboration across nation-states and across the*

consideration of the growing importance of the blue economy and the role of insurers within the blue sustainable finance principles.

public-private sectors, and on a scale that has not been previously achieved. This realization underscores the challenge facing the Small Island Developing States (SIDS) and Least Developed Countries (LDCs) as they turn to better managing their blue economies. The "blue economy" concept seeks to promote economic growth, social inclusion, and the preservation or improvement of livelihoods while at the same time ensuring environmental sustainability of the oceans and coastal areas" (World Bank and United Nations Department of Economic and Social Affairs, Report *The Potential of the Blue Economy: Increasing Long-term Benefits of the Sustainable Use of Marine Resources for Small Island Developing States and Coastal Least Developed Countries*, Washington DC, 2017, VI). For reports and information on the forms of cooperation among ESA and insurance companies *see* www.Space in support of the insurance sector - ESA Commercialisation Gateway, especially with reference to the projects E-Drift and CASSIA.

Davide Cipelletti

The Italian Use of Space: A Security Perspective

Summary: 1. Introduction – 2. The Italian legal framework and the Defence Space Strategy – 3. International cooperation – 4. Conclusion.

1. *Introduction*

In today's global landscape, space is an essential element for any modern society. The services provided by external space systems and technologies are now an integral part not only of military operations, but also of the daily functioning of civil society. Traditional financial and technological barriers in the field of satellites are progressively decreasing and, thanks to easier access and operating costs, more and more users can benefit from space services. The proliferation of dual-use applications has expanded the military uses of space and blurred the distinction between military and civil uses. However, the space domain has a dark side, as countries with divergent visions increasingly expose it to new risks, systemic vulnerabilities and intentional threats. The changed strategic framework of space has led to a renewed interest in the national space sector.

Italy already has a history and heritage with a great industrial capacity to reach space, to produce satellites and launchers. Our nation is the second country in Europe for the number of operational satellites in use today. Moreover, it is among NATO's top suppliers for communications from space. Space was immediately seen as a so-called enabling domain, meaning a domain that provides services to enable operations in the traditional domains (land, sea, area).

The space domain is undergoing a significant set of changes. A growing number of countries have taken part to the new space race and commercial actors are getting more and more involved in space, resulting in more innovation and benefits on Earth, but also more congestion (risks) and competition (threats) in space.

This has led to outer space being considered as an operational domain, as declared in 2019 by the NATO Secretary General, alongside land, sea, airspace and cyberspace. Italy is following the same path as NATO, as can be seen from the statement by the Minister of Defence at the hearing before the Joint Committees of the House and Senate "in a possible future, Space could be a place not only of technological opportunity, but also of clashes between countries". Most probably tomorrow, someone will try to fight in space knowing that today it is not the case, as the Latin saying goes: "*si vis pacem, para bellum*" (if you want to be in peace, prepare for war).

Security challenges in space are multiple and complex, reflecting society growing dependence on space technologies and intensifying geopolitical competition in this domain. One of the main challenges is the cyber threat, which might compromise satellite control systems and critical infrastructure on the ground, with potential repercussions on national and global security. Vulnerability to radiation represents another significant risk, as it can damage satellites' electronic systems and shorten their operational life. Furthermore, the risk of hacking and hostile interference increases the possibility of sabotage or unauthorized use of satellites and data.

The proliferation of space debris constitutes a growing danger to space missions, both inhabited and uninhabited, and requires careful management to avoid collisions that could have catastrophic consequences. The protection of industrial and military secrets is fundamental, as the theft of intellectual property relating to space technologies can have impacts on security and economic competitiveness. Finally, the challenge of ensuring the security of space communications is crucial, given that communications in space can be delayed due to large distances, requiring space devices capable of operating autonomously for long periods.

However, this growing dependence on space systems also exposes us to new risks. Systemic vulnerabilities and intentional threats become relevant concerns, as state and non-state actors can exploit these dependencies for hostile purposes. Security in space is not only about the physical protection of satellites, but also about the cybersecurity of transmitted data and the resilience of space infrastructure. Cyber threats, electromagnetic interference and collisions with space debris represent just some of the challenges that must be addressed to ensure the safe and secure use of space systems.

2. *The Italian legal framework and the Defence Space Strategy*

The process of reorganization of national space governance began in 2018 with the Law no. 7, "Measures for the coordination of space and aerospace policy and provisions concerning the organization and functioning of the Italian Space Agency"[1], which represents the main reference for the coordination of space policies and regulations until now. This law set up the Inter-Ministerial Committee (COMINT) as the authority to define the national government policies and strategic guidelines, as well as the legal framework. Representatives of the most significant ministries and the Italian Space Agency support it. The chief of the Space Policy Office of the Defence General Staff supports the Cabinet Office of the Ministry of Defence for COMINT-related functions and, more broadly, the political authority (President of the Council of Ministers, or the delegated political authority) for space-related military matters.

In accordance with the political guidelines, since 2019 the Ministry of Defence has started a process of rationalization and reorganization of the space sector which affected governance at strategic-military and operational level. This process led to the establishment of both an office at the joint staff level (Space Policy Office – SPO, reporting to the Chief of Defence) and an operational command (Space Operations Command - COS, reporting to the Joint Forces Operational Command) dedicated to space.

Established in 2019, the SPO is the office responsible for the definition and implementation of Defence space policy, for the development of national space capabilities, for the management of Defence programs and international cooperation, as well as for support to the Minister's Cabinet in activities relating to COMINT.

Established in June 2020, the COS is the operational level command with the objective of operating in space for the protection and defence of the national space infrastructure and of effectively integrating the space dimension into joint operations.

In 2022, the Defence Space Strategy was approved, directing the development and organization of the space domain to achieve the capability

[1] L. n. 7 del 11 gennaio 2018, Misure per il coordinamento della politica spaziale e aerospaziale e disposizioni concernenti l'organizzazione e il funzionamento dell'Agenzia spaziale italiana.
https://www.normattiva.it/atto/caricaDettaglioAtto?atto.dataPubblicazioneGazzetta=2018-02-10&atto.codiceRedazionale=18G00025&atto.articolo.numero=0&atto.articolo.sottoArticolo=1&atto.articolo.sottoArticolo1=0&qId=&tabID=0.5882992714622015&title=lbl.dettaglioAtto

to operate in space and to protect satellite systems of interest. In the same year, a legislative amendment gave the Italian Defence the responsibility in the management of space activities for security purposes. The objectives identified in the strategy are as follows:

1. Consolidate and evolve military capabilities instrumental in providing space support to operations and Force projection to ensure seamless availability of space-based telecommunications (SATCOM), Earth Observation (EO)[2], positioning, navigation and timing, and meteorology (including Space Weather) services.
2. Achieve as autonomous a capacity as possible to appreciate the situation in the space domain and achieve Space Domain Awareness (SDA) in a federative and cooperative manner, and exploit synergies between the Services as well as in the national, international and commercial fields.
3. Develop the ability to conduct active and passive defence space operations and consolidate and evolve autonomous military capability to operate on satellites, i.e., station-keeping[3], house-keeping[4] and payload management[5]. At the same time, develop – where appropriate – the ability to reconstitute compromised satellite capabilities through responsive launch to deter possible opponents from perpetrating hostile actions and defend the operational capability of own assets from any threat that might limit national freedom of access to and action in space.

3. *International Cooperation*

Consistent with the Defence Space Strategy, a rational and coherent capacity development path has been given impetus to consolidate and evolve defence space capabilities. However, there is no nation that might be capable of coping by itself with all the challenges that characterize the space domain.

In this sense, the Italian Defence is carrying out a number of activities to seek synergies at international level, such as:

[2] Monitoring for intelligence purposes, but also for the surveillance of borders and areas of national interest and in support of operational planning and operations.

[3] Operations aimed at maintaining the satellite's orbital parameters.

[4] Maintenance operations aimed at maintaining the operational efficiency of satellites.

[5] Payload management operations, aimed at monitoring, programming, operating, and maintaining the sensor in order to provide the expected capacity.

- ensuring expertise in the major policy, strategy and doctrine initiatives such as, for example, the UN Open Ended Working Group (OEWG) on reducing space threats through norms, rules and principles of responsible behaviors within the United Nations, the EU Space Strategy For Security And Defence and the new NATO Allied Joint Publication on space operations.
- supporting intense bilateral activities with other spacefaring nations and key allied partners, such as the United States, which has led to the opening of discussion tables on political and operational issues and France, in full adherence to the institutional mandate resulting from the signing of the Quirinal Treaty in November 2021.

Finally, the Italian Ministry of Defence recently become a member of the Combined Space Operation Initiative (CSPO), a discussion forum aimed at promoting the definition of a shared path in the evolution of space as a domain of operations.

4. *Conclusion*

Italy has historically demonstrated considerable industrial capacity in the space sector, from the production of satellites and launchers to participation in international space programmes. This solid industrial and technological background provides an excellent basis for the further development of national space capabilities.

In the light of growing risks and threats, Italy, in line with NATO and other major international partners, considers space not only as an enabling domain, but also as an operational field requiring specific defence and security capabilities.

The emergence of new space actors and the rise of commercial activities in space present both opportunities and challenges. Economic competition for space resources, such as those of the Moon, requires a defensive presence to protect national interests in the outer space.

In this sense, a regulatory framework for access to space, inspired by the principles of security, sustainability and resilience of space infrastructures, is highly needed. This framework should reflect the approach promoted by Defence in the development of the space sector, according to which there is no economic development without security.

In this perspective, the security of space activities in all its phases and the resilience of the satellite infrastructure against risks and threats should be the minimum requirement for all space operators. The Ministry of Defence will naturally play a central role in verifying the compliance of space actors with the above-mentioned standards, ensuring that every aspect of a space activity meets stringent security protocols and that missions are conducted responsibly, with a focus on minimizing risks and maximizing the potential for successful outcomes.

In accordance with the Defence Space Strategy, national and international cooperation is a key element to ensure the sustainable development of the domestic space sector. Italy recognizes the need to actively participate in scientific and commercial missions in space, developing capabilities that can also be used for military and defence purposes. Italy will also continue to seek synergies and collaborations with historical allies and like-minded countries, in order to strengthen deterrence against potential adversaries, share know-how and expertise to evolve capabilities and keep pace with technological development and the evolution of the threat.

In conclusion, the strategic importance of space for Italy is manifold and integrates aspects of security, economics and scientific progress. The growing dependence on space systems and the emerging challenges require a coordinated strategic approach, supported by a solid industrial base, an effective governance and a specific regulatory framework. Italy is well positioned to address these challenges and exploit the opportunities offered by space, contributing significantly to global security and progress.

Marco Di Giugno

A Regulatory Framework for the Prospective Commercial AeroSpace Transportation Operations in Italy

Summary: 1. Introduction – 2. The legal regime applicable to spaceplanes – 3. Italian regulation for spaceplanes as experimental aircraft – 4. Spaceports management and requirements: ENAC Regulation on construction and operation of spaceports (ED. 3 2023.12.14).

1. *Introduction*

Several operators have started their commercial operations with spaceplanes: in particular, on July 20, 2021, Blue Origin successfully completed its first crewed mission, Blue Origin NS-16, into space using its New Shepard launch vehicle. The flight was approximately 10 minutes and crossed the Kármán line. New Shepard performed six crewed flights between July 2021 and August 2022, taking a mix of sponsored celebrities such as Wally Funk, William Shatner as well as paying customers.

Virgin Galactic conducted its first commercial SpaceShipTwo suborbital flight June 29, 2023. Virgin Galactic's SpaceShipTwo vehicle VSS Unity, separated from its VMS Eve mothership aircraft at about 11:29 a.m. Eastern above cloudy skies in southern New Mexico. The vehicles took off from Spaceport America at 10:30 a.m. Eastern.

Italy – also thanks to the ENAC-FAA Memorandum of Cooperation of 12 March 2014, recently renewed and extended to Agenzia Spaziale Italiana - ASI and with the valuable support of Italian Air Force - ITAF – has the potentiality to allow this kind of operation from its territory under an ad hoc regulatory framework that can be set out in accordance with the Italian Air Navigation Code.

According to recognized definitions (e.g. the ICAO definition) a spaceplane involved in commercial space flight operations must be considered an aircraft; moreover, it appears clear, that, in a European environment, future commercial space-flights design, production, maintenance, operations and licensing activities shall be carried out under the EU and EASA legal and regulatory framework, that in any case, for the time being, hasn't been set up, yet.

Meanwhile, in order for operators to be allowed to start space-flight operations from Italy in a (relative) short term, ENAC envisages the possibility that sub-orbital spaceplanes shall be considered as "aircraft specifically designed or modified for research, experimental or scientific purposes, and likely to be produced in very limited numbers" and therefore operated, under the Italian national rules, as provided in Annex I of the present EU Basic Regulation (EC) No. 1139/2018.

In this respect, due to the fact that experimental aircrafts are not normally allowed to conduct commercial operations, specific exemptions could be issued for spaceplanes and, as an example, flight crew and participants should have to be duly informed, before flight, of the inherent risks of the operations and acknowledge receipt of this information in writing as informed consent. In doing so, these paying participants will also acknowledge and accept that they will not benefit from the normal safeguards expected for commercial transport (they are therefore not considered passengers in the traditional sense).

It is of paramount importance to be clear about the risks with the involved people. In fact spaceplanes cannot currently achieve the same safety standards as commercial aviation (if never they will be able to do it); therefore before allowing spaceplanes to operate from Italy, the Government should be aware of and accept that these kind of operations carry a higher degree of risk than most consolidated aviation operations, at least for the people on board.

On the other hand, the risk for the uninvolved general public (i.e. the thirds and the goods on ground) should be protected against the risks coming from this kind of operations at the same (accepted) level of the current commercial aviation or, at least, at the same level of the corresponding segment of manned aviation (a similar approach has been following by ENAC about the risk for thirds parties on ground coming from unmanned aircraft operations, based on the ICAO equivalence principle).

One of the most important factors in protecting the uninvolved general public is the choice of a launch site for spaceplanes – a spaceport, with adequate characteristics. These consist first of all by easy access to the sea and low population density in the region of the spaceport.

There is a possibility of using military infrastructures at least at the beginning waiting for the definition of a national regulation for civil spaceports that could allow the conversion of the actual civil aerodromes into spaceports or built new ones.

Another solution could be an airport already designated for experimental unmanned aircraft activities complying with spaceport ad-hoc requirements, like the Taranto-Grottaglie airport which has been already set up as a "test bed" for this purpose.

So, considering the development of commercial space travel with winged vehicles having take-off and landing capabilities potentially from a consistent number of locations within a same country, engaging aviation space with sub-orbital paths and trajectories impacting the consolidated commercial and general aviation traffic and providing services for human and good transportation, ENAC, the Italian Civil Aviation Authority, has considered it necessary to start a progressive involvement in the aerospace sector.

The above has led to the signing of a non-binding "Memorandum of Cooperation on Commercial Space Transportation Development" between ENAC and the FAA on March 12, 2014 and a number of valuable meetings and workshops among ENAC, FAA AST (Office of Commercial Space Transportation) and ITAF (Italian Air Force), the latter under an additional agreement for cooperation with ENAC for the scope of developing procedures and standards to support flight test activities of commercial sub-orbital flights within Italian National Air Space.

The renewed Memorandum of Cooperation FAA-ENAC-ASI signed in Rome last 30 June 2016, and the associated continuing cooperation with ITAF, provide further impulse to ENAC to become a qualified reference point for the perspective (initially experimental and subsequently operational) activity of suborbital space vehicles in Italy.

2. *The legal regime applicable to spaceplanes*

The legal regime applicable to spaceplanes depends on the definition for "Outer Space" and the boundary for where it begins.

A useful convention would be to consider outer space the region above and outside the Karman line (100km or 1,57% of Earth's radius) but the issue whether it is possible or useful to establish a legal boundary between airspace and outer space has been debated in the doctrine since the beginning of space missions. The conventional and informal limit of 100 km, indeed, is often referred to as separating air and space operations:

some States have included it in their national legislation[1] but there is no consensus at global level. For the space community, space operations seem to relate to operations aimed at going to or placing an object in orbit, the lowest circular unpropelled orbit being at around 150 km altitude (at this altitude, a space object only makes a few 90-minute orbits before the drag and fast orbital decay makes it re-enter)[2].

The ICAO Legal Committee[3] and the UN COPUOS have suggested to look at the purpose or intent of the flight ('functionalist approach') to determine whether it is a space or aviation operation: flights which would be passing merely in transit through (sub)orbital space in the course of an earth-to-earth transportation would remain subject to air law.

The implication of a strict outer space delimitation on sovereign rights and national security against progress of space technology reflected on the fact that no agreement still exists on a fixed airspace-outer space boundary, while a large consensus has been reached on the five space treaties[4].

Although spaceplanes are not mentioned in the above treaties, it seems appropriate that, for the portion of mission where a spaceplane behaves as a spacecraft (namely when it cannot derive support from interaction with the surrounding air) the space law is applicable.

This implies, briefly, that each State is responsible that space activities carried out by State citizens or organisations are consistent with the international obligations of the State and do not jeopardise public health or the safety of persons or property. Moreover, the State must provide and update a register of space objects launched and accept liability for third party damage.

Besides, according to the ICAO definition of "aircraft", spaceplanes can

[1] E.g. Australia, Denmark.

[2] The new US Space Regulation Part-450 provides that no LCOLA (launch collision avoidance) analysis is needed for missions that do not exceed 150 km in altitude because orbital objects below this level are exceedingly sparse and usually are not present for long durations.

[3] ICAO Legal Committee LC/36 WP/3-2.

[4] There are five United Nations treaties and agreements applicable to space: 1. Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 1967 ("Moon Agreement'); 2. Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies ("Outer Space Treaty"); 3. Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 1968 ("Rescue Agreement"); 4. Convention on International Liability for Damage Caused by Space Objects ("Liability Convention"); 5. Convention on Registration of Objects Launched into Outer Space ("Registration Convention").

undoubtedly be considered aircraft for the portion of mission where they derive support in the atmosphere from the reactions of the air; therefore the existing set of civil aviation safety regulation (aviation law) would also apply to them and, generally speaking, to spaceplanes commercials operations because involving paying participants or goods on board.

In the EU, safety aviation rules are prepared by EASA and issued by the EU Institutions (Parliament – Council - Commission) in the form of regulations covering aeronautical product certification, continuing airworthiness, personnel licensing, aircraft operations, aerodrome and airspace/air navigation. Within this framework, since spaceplanes used for spaceflight experience would be providing air transport, they would be expected to comply with the standards for air commercial transport which are generally more demanding than those for general aviation or light aircraft. During last year, following a mandate by the European Commission, and with the support of a Task Force of Member States, EASA explored the preparatory actions required for a future regulatory framework on higher airspace operations (HAO) above FL 550. These operations which do not yet exist on a large scale in Europe can initially be defined as 'air transport operations carried out by various types of aircraft or vehicle systems in the volume of airspace above altitudes where the majority of air services are provided today (i.e. above FL 550)'.

Building on the work done in parallel by the ECHO project (SESAR JU/Eurocontrol), the Task Force identified 27 categories of future HAO vehicles and operations, some of which fall under the applicability of the Chicago Convention and of the EU Regulations on civil aviation. This is the case for instance of HAPS, supersonic and hypersonic aircraft operations. Other vehicles and operations qualify as space operations and remain under the competence of Member States, while others present hybrid characteristics that will deserve further assessment.

Following an initial analysis of the impact of future HAO on the existing EU regulatory framework from a total system perspective, it can be concluded that while the EU Treaties and Basic acts allow for some of these operations and give a shared competence to the EU to regulate some of them, notably those qualifying as civil aviation operations performed by aircraft under the scope of the EU regulations, most of the current implementing rules would have to be adapted and/or new ones adopted; for instance in the domains of airworthiness, operations, ATM/ANS, environment, aerodromes, personnel licensing, etc. Since some of these operations will be unmanned, synergies with the drones regulations will also have to be further assessed. This Roadmap summarises the findings of the Task Force as well as the reflection of the various services of the Agency, and presents them in the format of a pre-impact assessment, for delivery to the European Commission in order to support its decision on the follow-up of this file.

A further option derives from the possibility for spaceplane operations to be exempted from EASA regulation. As a matter of the fact, although EU has legal competence, it has not exercised that competence so far because no regulation specifically applicable to spaceplanes has been issued, yet. In this framework, and similarly to aircraft, personnel and operations excluded from applicability of EASA Basic Regulations (ref. Reg. (EC) No 1139/2018, Annex I (b) "aircraft specifically designed or modified for research, experimental or scientific purposes, and likely to be produced in very limited numbers"), Member States may consider to be entitled to regulate spaceplane operations nationally.

In other words, in the transition period until EU would issue specific regulations for spaceplanes and their operations, Member States might classify spaceplanes as experimental aircraft and therefore apply national standards.

3. *Italian regulation for spaceplanes as experimental aircraft*

To build up a national legal and regulatory framework allowing suborbital flights in Italy, a three phases approach is envisaged:

· Phase I – Experimental flights (near term)

· Phase II – Flights with participants on board (mid term)

· Phase III – Routine transport (long term).

It should be mentioned that the Italian Air Navigation Code does not provide any altitude limitation for air navigation of the objects defined as aircraft, nor include a definition of spacecraft (or spaceplanes) as flying objects different from aircraft. A formal legal approach to the future scenario of commercial space transportation, in particular for sub-orbital vehicles performing horizontal take-off and landing, will be a need in the future, but the present content of the Air Navigation Code is not considered as a legal obstacle for the development of Phase I i.e. experimental sub-orbital activity of spaceplanes.

For this purpose a lift-supported spaceplane could be considered an aircraft i.a.w. ICAO definition – “Any machine that can derive support in the atmosphere from the reaction of the air”.

In the framework of current Italian national aviation regulation, experimental aircraft are not allowed to conduct commercial transport operations; however exemptions might be granted that, subject to specific conditions and limitations, permit occasional sub-orbital spaceplanes flight experience for paying participants and cargo.

The proposal of exemptions and the definitions of conditions and limitations should be based on and should take into account the following considerations:

1. Spaceplanes operations should not imply a risk to uninvolved persons and properties higher than the one caused by current aviation traffic.
2. Presently, spaceflight is an inherently high-risk activity, where both technology and operational experience are under development. Each person directly involved in spaceplanes operations on board (e.g.: flight crew, cabin crew, participants) or at ground (e.g.: during launching, take-off or landing phases) and any customer under contract for cargo transportation should have been aware of such a risk (potentially affecting health and properties on board) by the operator and should be in condition of understand it. A written acknowledgement of such a risk should be signed for each operation (informed consent).
3. Informed consent does not absolve the operator from liability claims brought by involved parties, their families or legal represent ant in the event of death or serious injury following a spaceplane accident or serious incident. Nor informed consent does absolve the operator from adopting policies aiming at constantly improving the overall safety of the operations.
4. Modern airplanes in commercial operations achieve a catastrophic failure rate better than 10-7 per FH, general aviation standards are better than 10-4 per FH: a figure of 10-4 per FH should be established as the acceptable target for short term spaceplanes sub-orbital operations.
5. In the short term, due to the fact that spaceplanes operations most likely to start in the coming years will be by USA operators and developed in accordance with US standards, any national regulation proposed should take into consideration and possibly be compatible with those standards. The option to adopt entirely or part of the USA (FAA AST) regulation for all commercial spaceplane activities should be taken into consideration, as well.

6. In the longer term, the aim of National regulation for commercial spaceplane operations will be to arrive at a risk-based regulatory framework and to encourage an acceptable level of safety without constitute an unnecessary burden for the development of this new industry. Adequate flexibility to allow for future regulatory development in the EU should be the target, also.

All these issues are handled in the "*SUBORBITAL AND ACCESS TO SPACE OPERATIONS (SASO) REGULATION*" adopted by ENAC in 2023.12.14.

The SASO Regulation contains the requirements a vehicle system operator has to comply with in order to be authorised to conduct suborbital operations or operations for access to space (e.g. launching into orbit) or re-entry from orbit. Crewed and uncrewed operations, with or without occupants on-board, are in the scope.

The regulation is composed of five sections from Section I to Section V. Scope, applicability, definitions and general requirements valid for each type of operations are set forth in Section I and II. Suborbital operations requirements are set forth in Section III, while launching into space and re-entry from orbit requirements are set forth in Section IV and V respectively. Performance based flightworthiness requirements are set forth in Annex 1 of this regulation and are applicable to vehicles with occupants on-board, irrespective of the type of operation carried out. Orbital operations after the entry into orbit or before deorbit are not in the scope of this regulation.

For the time being only Sections I, II and III, and Annex 1 are available. Sections IV and V are under development and will be added into the regulation in a later stage.

This regulation follows a risk-based and operation-centric approach aimed at issuing to the vehicle system operator a single authorization, either a licence or an experimental permit, that considers the operation as a whole and covers all the relevant domains. Moreover, the requirements are performance-based wherever possible.

Two main domains are addressed, namely the public safety (aka third party safety) and the occupants' safety, while occupants' safety requirements are performance-based, due to the need to cover different classes of vehicles, the public safety requirements are more prescriptive and quantitative.

In order to allow innovation and to take into account different vehicle system architectures and solutions, the Annex 1 of this regulation provides flightworthiness performance-based requirements for the design of vehicle system intended to carry occupants on-board, which shall be used to develop detailed consensus standards tailored to the specific categories of vehicle systems. In other words, occupants' safety requirements are objective requirements whose aim is to provide mandatory guidance to develop the consensus standards that may be used by the applicant to design the vehicle, provided they have been approved by the authority. In general, consensus standards will be approved by the authority if they are recognized in compliance with the objective requirements of this regulation.

The regulation would like to be adaptive in principle, and as such it will be updated as necessary following the evolution of the sector and based on the data and experience coming from the operations and also gathered from the regulatory sandboxes that may be implemented for possible specific types of operations that may not completely fit the current regulation.

Space crew requirements and licensing.

Historically, space crew started being selected from military services and have continued this way for the majority of missions; therefore, the majority of spacecraft crew to date have been highly trained and physically fit, even before selection for a space mission.

As operations have evolved, longer missions with larger crews have become possible and specialised roles with different skills for crew members have developed. Depending on the spaceflight programmes, the responsibility to ensure that crew members were appropriately trained and competent has been managed by the respective national space agencies.

As the spaceflight scenario will progressively move from experimental to commercial operations, it can no longer be assumed that either space agencies or military administrations take responsibility for commercial flight crew training and competence and, as for general and commercial aviation, either national aviation Authorities or EASA are expected to set their own regulation.

Since, as in aviation, the safety of the operations depends also on the skills and knowledge of the spaceflight crew and, specifically for spaceflight operations, on the ability to cope with the unique stresses of spaceflight, spaceflight crew licensing model would need to address both technical competence and physical ability.

Since that all the operators candidates for experimental or commercial spaceflight operations in the near term are from USA, the ENAC regime for, both spaceplane and its crew is inspired by FAA AST requirements.

In particular, US FAR Part 460, places a responsibility on operators to ensure that all members of the flight crew: have appropriate experience; are appropriately trained for their craft; and have demonstrated an ability to withstand the stresses of spaceflight in sufficient condition to safely carry out their duties so that the vehicle will not harm the public. The option to validate FAA AST process is probably the most convenient and suitable for the near term. In accordance with Annex III to Regulation (UE) No. 1178/2011 (the Aircrew Regulation), this should be accomplished by a validation process, which requires the pilot to hold a valid ICAO-compliant licence; hold at least a Class 1 Medical Certificate issued in accordance with Annex IV to to Regulation (UE) No. 1178/2011 - Part-MED; - have successfully completed a skill test on the appropriate aircraft or in a synthetic training device designed to replicate the operation of the aircraft, with an examiner designated by the competent authority.

In case operations will be conducted on spaceplanes classified as experimental aircraft under Annex I of the EASA Basic Regulation, ENAC as the competent authority could add further requirements.

Medical requirements and assessment for space crew.

Like in aviation, the fitness and performance of commercial space crew clearly has to be assured not only for their and any participant's protection, but also to protect, as far as possible, the uninvolved general public.

Since space environment and spaceplane operations imply additional issues and constraints than those in aviation, aviation standards for flight crew could be conveniently considered as a baseline from which a specific standards needs to be developed and established.

So far, although specific standards have been established for the International Space Station astronauts[5] and some draft policies begin to address the issue for shorter space experiences[6], there are currently no common standards that apply to sub-orbital operations.

The ENAC Regulation require an adequate medical standard for space crew and commitment the relevant assessment to a medical national network are mandatory steps in order to set a system similar to the one

[5] E. Messerschmid, J.-P. Haigneré, K. Damian, V. Damann (2000) 'EAC training and medical support for International Space Station astronauts'.

[6] FAA AST (2013) 'Draft Established Practices for Human Space Flight Occupant Safety'; J-B Marciacq and A Ruge (2013) 'Sub-orbital and orbital pilots licensing and passengers medical screening/training', International Astronautical Association (IAA) 19th Humans In Space Conference, Cologne; Aerospace Medical Association Commercial Spaceflight Working Group (2011) 'Position paper: sub-orbital commercial spaceflight crewmember medical issues'.

for commercial aviation. While the latter can be conveniently provided by the current established aviation national network of aeromedical centres with some additional information and training, the former needs adequate European or even worldwide harmonisation.

Medical requirements and assessment for participants.

At the current state of the art and technology, spaceplane flights will expose both participants and flight crew to hazards at levels not usually encountered in commercial air transport, such as reduced ambient pressure, a reduced oxygen level, high G, microgravity, high noise levels, increased radiation exposure, vibration and thermal extremes.

Not only the above conditions may have consequences on the affected participants, even the safety of entire space or sub-orbital mission might be in danger due for example to an anomalous/unwanted behaviour or illness of a participant if no adequately managed.

SASO Regulation at point HUM.160 identify medical requirements for participants inspired by what aviation commercial operations do for the screening of passengers with medical conditions who could potentially suffer from a commercial aviation flight.

The ENAC regulation will have to be consolidated by national legislation which will have to codify the aspects relating to the operator's liability (in particular will be explored the possibility to introduce a regime of CROSS WAIVER OF LIABILITY) as well as the insurance profiles, identifying a limit above which the launch status will guarantee compensation for any damage that may exceed this limit.

The draft of the Space Law, based on the study carried out by the "Fondazione Leonardo" in collaboration with "Bocconi" and "La Sapienza University" is currently being discussed at the ministerial level (Ministry of Business and Made in Italy). This law will have to identify the competent authorities for regulatory activity for pure space activity and for the so-called "space access" activity. Through publication of the SASO Regulations and the new Edition 3 of the coordinated "Construction and Operation Regulations of Spaceports" Regulation, along the lines of what already happens at an international level, and for example in the USA[7], in the UK and in Norway, in particular, ENAC can strengthen its candidacy

[7] In the USA, the authority responsible for evaluating and issuing permits and licenses to non-governmental operators of launch vehicles and launch sites is the "Office of Commercial Space Transportation (AST)" established in 1984 and which since 1995 has been a body within the Federal Aviation Administration (FAA) which reports to the Department of Transportation (DoT).

to be recognized, also legislatively, as a regulatory authority for spaceports, the suborbital flight, access to space and return from orbit, also taking into consideration regulatory activity already done.

4. *Spaceports management and requirements: ENAC Regulation on construction and operation of spaceports (ED. 3 2023.12.14)*

The identification of a suitable spaceport is a necessary condition to allow spaceplane operations from Italy. The needs for a suitable spaceport location are related to operations, safety, meteorological conditions and economic factors, therefore a trade-off is necessary.

The spaceport is a strategic infrastructure essential to implement suborbital transportation operations and access to space, in order to ensure a sustainable development of the sector of commercial suborbital flights, pursuant the directives of the Minister of Infrastructure and Transport (MIT).

The spaceport is a site that includes infrastructures, buildings, equipment, plants and systems which are used to execute the launch, the landing and the related ground and flight operations of a suborbital HOTOL vehicle (horizontal take-off and horizontal landing), where the launch and landing of which can be, respectively, compared to the horizontal take off and the landing of an aircraft (Horizontal Spaceport).

In order to avoid improper use of land and to make the best use of the infrastructural resources present, the spaceport is identified in the area of an aerodrome certified under the Regulation (EU) no. 139/2014 and owning an ICAO code of flight infrastructure suitable for the characteristics of the suborbital vehicle that will operate there. The use of the main infrastructures, primarily the runway, will be shared and, normally, it will not be simultaneous.

In the ENAC Regulation there are legal requirements regarding the specificity of the suborbital transport operations that characterise the spaceport if compared to an aerodrome, which, similarly, need to be respected by the spaceport operator in order to be allowed to operate. From the point of view of the security, the same European and national aerodrome access rules for goods, operators and both means of the spaceport operator and external, as well as flight crews, are applied also to the spaceport. The occupants of a suborbital flight others than crew which, for any reason, participate to the flight, are allowed to enter the security restricted area after specific and dedicated screenings, as defined in the Regulation. The certification as spaceport is issued by ENAC to the operator (applicant for certification) prove that in the spaceport is possible to safely operate at least one typology of suborbital transport with at least one typology of suborbital vehicle. Excluding the operations whose responsibility is shared between the Airspace Operator and the providers of the Air Navigation Services, all the operations that are carried out in the spaceport are under the responsibility of the spaceport operator. This is because it represents "the subject entrusted with the task of administering and managing the aerodrome infrastructures, together with other activities or exclusively, in accordance with criteria of transparency and non-discrimination, under the control of ENAC". At the same time the spaceport operator is responsible of the spaceport infrastructures and to "coordinate and control the activities of the different private operators in the aerodrome" and, consequently, in the spaceport, as stated in the art. 705 of the Air Navigation Code.

The Regulation defines the conditions to issue, maintain, modify, limit, suspend and cancel the spaceport certification and the related obligations and responsibilities of the spaceport certification holder, with regard to the safety of the suborbital horizontal take-off and horizontal landing transport operations. Furthermore, this Regulation determines the general conditions of applicability, implementation and regularity of rescue and fire prevention services. The technical requirements to set up the services are reported in the regulation of the Ministry of Interior - National Department of Fire Brigades.

ENAC issues this Regulation in line with the guiding act of the 10th of July 2017 n. 354 of the Minister of the Infrastructure and Transport about the sustainable development of the commercial suborbital flights sector.

ENAC strongly believes Italy has the potential and the capability for hosting one or more spaceports that could meet the necessary requirements, even if, at this moment, only one site (Grottaglie Airport) has been identified.

In order to allow spaceplanes operations in Italy, this work may be initially done in cooperation with ITAF and the Italian MoD, so ENAC founded "Criptaliae Spaceport" (from the ancient name of Grottaglie), to allow ENAC, Aeroporti di Puglia and the other public entities involved (ENAV and the Military Aviation Authority) to manage the spaceport and to intercept the demand for innovative services in the aerospace sector, of a public and private nature, within the central institutional framework

(Government, ENAC) and local (Puglia Region).

Even if the first location of a spaceport is in a coastal area in the South of Italy, in the future, with a better understanding of sub-orbital spaceplane safety performance and the possibility of the development of suitable certification codes, it may be possible to relax the coastal location requirement (that is directly linked to the low-population density requirement), even if a coastal location can, in any case, help to meet some environmental requirements.

Frans von der Dunk

Property Rights in Space: Where Does the Law Stand Now?

Summary: 1. Introduction: property rights in outer space? – 2. Rights over immovable property and outer space – the discussion on Article II of the Outer Space Treaty – 3. National developments contributing to an interpretation of Article II of the Outer Space Treaty – 4. Concluding remarks.

1. *Introduction: property rights in outer space?*

In discussing the issue of 'property rights in outer space', it should first be clarified that at a general level there might be three categories of property rights at issue.

First, there is the issue of 'intellectual property rights', the rights that individuals or other right-holders might enjoy when it comes to exclusively using, marketing and/or selling the results of intellectual efforts.[1] This concept is not mentioned in the Outer Space Treaty[2], the seminal convention of 1967 providing the legal framework for all space activities,

[1] *Cf. e.g.* the definition by the World Trade Organization of intellectual property rights as "the rights given to persons over the creations of their minds. They usually give the creator an exclusive right over the use of his/her creation for a certain period of time."; https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm (last accessed 26 June 2024); or, a bit more extensively, "the legal rights given to the inventor or creator to protect his invention or creation for a certain period of time. These legal rights confer an exclusive right to the inventor/creator or his assignee to fully utilize his invention/creation for a given period of time."; C.N. Saha & S. Bhattacharya, Intellectual property rights: An overview and implications in pharmaceutical industry, 2(2) *Journal of Advanced Pharmaceutical Technology & Research* (2011), 88.

[2] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (hereafter Outer Space Treaty), London/Moscow/Washington, done 27 January 1967, entered into force 10 October 1967; 610 UNTS 205; TIAS 6347; 18 UST 2410; UKTS 1968 No. 10; Cmnd. 3198; ATS 1967 No. 24; 6 ILM 386 (1967).

or indeed any other of the core space treaties[3]. This essentially means that the potential application of intellectual property rights in the context of space activities is not fundamentally different from its application in other domains, albeit that some States have taken the step of at least legislating in general terms on the concept and addressing its application in the particular context of outer space and space activities[4].

Second, there is the issue of rights over 'movable' property, basically any physical item that can be moved and potentially be subject to someone 'owning' it, as opposed to untouchables such as 'air' or 'radio frequencies'. Here, given the nature of outer space as a realm following Article II of the Outer Space Treaty beyond the territorial jurisdiction of any particular State presenting a kind of 'global commons' or *res extra commercium*[5], it was considered prudent by the drafters of the Outer Space Treaty to reiterate that "[o]wnership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth."[6] In other words: any item on Earth legally belonging to someone, remains the property of that person even if sent into outer space and/or coming back therefrom to Earth.[7]

It is the third category of property, of immovable property – in terrestrial terms: real estate and anything 'immovable' on (such as buildings) or in (such as mining corridors) it – and the rights thereover, which has recently triggered substantial discussions in particular in the realm of outer space and space activities. It is this category, therefore, which will constitute the subject of further discussion by the present article.

---

[3] See further *e.g.* C. Doldirina, Intellectual property rights in the context of space activities, in *Handbook of Space Law* (Eds. F.G. von der Dunk & F. Tronchetti)(2015), 949-94; more succinctly, F.G. von der Dunk, *Advanced Introduction to Space Law* (2020), 94-8.

[4] *Cf. e.g.* the US Patents in Outer Space Act, 15 November 1990, Public Law 101-580; 35 U.S.C. 10; 104 Stat. 2863; which essentially ensures the applicability of US patent law to inventions made on board of US-registered space objects.

[5] See further F.G. von der Dunk, International space law, in *Handbook of Space Law* (Eds. F.G. von der Dunk & F. Tronchetti)(2015), 55-60; S.R. Freeland & R. Jakhu, Article II, in *Cologne Commentary on Space Law* (Eds. S. Hobe, B. Schmidt-Tedd & K.U. Schrogl) Vol. I (2009), esp. 49-58.

[6] Art. VIII, Outer Space Treaty (*supra*, n. 2).

[7] See further *e.g.* B. Schmidt-Tedd & S. Mick, Article VIII, in *Cologne Commentary on Space Law* (Eds. S. Hobe, B. Schmidt-Tedd & K.U. Schrogl) Vol. I (2009), 163-4.

2. *Rights over immovable property and outer space – the discussion on Article II of the Outer Space Treaty*

2.1. *Introduction*

That the issue of rights over immovable property in the context of outer space has become such a major issue fairly recently, is the consequence of a number of developments regarding potential 'space mining' operations and, beyond that but closedly related to it, the prospect of long-duration human habitats on the Moon and some other celestial bodies.[8]

Given that the Moon Agreement[9] of 1979, which at the time was at least partially meant to address these issues[10], never achieved widespread formalized adherence[11], only those elements of the agreement which were not controversial and merely seen as elaborating provisions of the Outer Space Treaty in the context of the Moon and other celestial bodies[12] might be relevant in this context. In consequence, the legal answers to questions regarding the possible or actual rights of States and other entities to immovable property in outer space reside almost exclusively in the Outer Space Treaty.[13]

[8] See *e.g.* for more detail F.G. von der Dunk, Property Rights Over the Moon or On the Moon? The Legality of Space Resource Exploitation on Celestial Bodies, 6 *Journal of Law & Innovation* (2023), 96-7.

[9] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (hereafter Moon Agreement), New York, done 18 December 1979, entered into force 11 July 1984; 1363 UNTS 3; ATS 1986 No. 14; 18 ILM 1434 (1979).

[10] See further *e.g.* F. Tronchetti, Legal aspects of space resource utilization, in *Handbook of Space Law* (Eds. Eds. F.G. von der Dunk & F. Tronchetti)(2015), esp. 782-92; S. Hobe, P. Stubbe & F. Tronchetti, Historical Background and Context, in *Cologne Commentary on Space Law* (Eds. S. Hobe, B. Schmidt-Tedd & K.U. Schrogl) Vol. II (2013), 336-7.

[11] As of today, following the recent withdrawal by Saudi Arabia from the Agreement, only seventeen States are parties to it, none of which can be considered major spacefaring countries (with the possible exception of Australia); see Status of International Agreements relating to activities in outer space as at 1 January 2024; A/AC.105/C.2/2024/CRP.3*, of 15 April 2024; 5-9.

[12] *Cf.* Tronchetti (*supra*, n. 10), 782 *ff.*; Von der Dunk (*supra*, n. 5), 99-103.

[13] *Cf.* further *e.g.* Statements of the Board of Directors of the International Institute of Space Law (IISL) of 2004 and 2009, at www.iislweb.org/docs/IISL_Outer_Space_Treaty_Statement.pdf (last accessed 26 June 2024) and www.iislweb.org/docs/Statement%20BoD.pdf (last accessed 26 June 2024) respectively; also already F.G. von der Dunk *et al.*, Surreal estate: addressing the issue of 'Immovable Property Rights on the Moon', 20 *Space Policy* (2004), 149-56.

2.2. *Article II and other clauses of the Outer Space Treaty*

Unfortunately, as a result of a profound lack of expectations that mining of and human settlement on celestial bodies – especially the Moon – would become a reality anywhere soon, the Outer Space Treaty has very little to say about this issue specifically. The main relevant clause is Article II, already mentioned before, which provides in full: "Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."

The nature of this provision as prohibiting the exercise of any territorial sovereignty in outer space, and consequently also the (public or private) ownership of any part of outer space, including of celestial bodies, under whatever national legal regime providing for immovable property rights, is thus evident and generally undisputed. However, the related yet fundamentally different and currently much more topical question of what that means exactly for rights to exploit resources in such realms or to develop quasi-permanent human settlements there, is not addressed in any detail.

To some extent, further clues can be garnered from other provisions of the Outer Space Treaty. Thus, Article I provides for the freedom of space activities for States as more or less the baseline for the legal regime applicable to outer space[14]; Article III requires any space activities to comply with whatever international law is applicable as presenting the main limitations to that baseline freedom[15]; Article IX imposes a generic duty upon States to take the interests of other States into (due) regard[16]; and Article XII provides that "[a]ll 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", evidencing a belief that, as such, the establishment of such stations, installations and equipment as well as the landing of space vehicles on celestial bodies is legal[17].

All these clauses, however, fail to address the fundamental question of

[14] See further *e.g.* S. Hobe, Article I, in *Cologne Commentary on Space Law* (Eds. S. Hobe, B. Schmidt-Tedd & K.U. Schrogl) Vol. I (2009), 33-6.

[15] See further *e.g.* O. Ribbelink, Article III, in *Cologne Commentary on Space Law* (Eds S. Hobe, B. Schmidt-Tedd & K.U. Schrogl) Vol. I (2009), 67-9; also Hobe (*supra*, n. 14), 36-40.

[16] See further *e.g.* S. Marchisio, Article IX, in *Cologne Commentary on Space Law* (Eds S. Hobe, B. Schmidt-Tedd & K.U. Schrogl) Vol. I (2009), 174-9.

[17] See further *e.g.* L.J. Smith, Article XII, in *Cologne Commentary on Space Law* (Eds S. Hobe, B. Schmidt-Tedd & K.U. Schrogl) Vol. I (2009), 209-13.

whether and/or to what extent the absence of territorial sovereignty over any part of outer space limits or even precludes the possibilities to obtain property rights over *resources* as opposed to *areas* of celestial bodies, and as a consequence to exploit natural mineral resources in that realm. At the same time, at the theoretical level there would be two inherently logical but as between themselves irreconcilable interpretations of that foundational provision.[18]

2.3. *The two opposite interpretations of Article II of the Outer Space Treaty*

On the one hand, the argument would run that, since outer space in the absence of territorial sovereignty effectively belongs to all of humankind – more or less like the high seas[19] and the airspaces above it[20] – all natural mineral resources to be found herein also belong to all of humankind. The Moon Agreement specifically further developed such an interpretation by way of labelling celestial bodies and their natural resources the "common heritage of [hu]mankind"[21] and calling for an international regime, presumably even including an international licensing regime, to regulate commercial exploitation, including assurances that all States would somehow benefit from such exploitation[22].

The obvious corollary here was the law of the sea, where the deep seabed, also declared the 'common heritage of (hu)mankind', was subjected

[18] Note that Art. 31(1), Vienna Convention on the Law of Treaties, Vienna, done 23 May 1969, entered into force 27 January 1980; 1155 UNTS 331; UKTS 1980 No. 58; Cmnd. 4818; ATS 1974 No. 2; 8 ILM 679 (1969); provides for the baseline rule of interpretation of treaty clauses as follows: "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."

[19] *Cf.* esp. Art. 89, United Nations Convention on the Law of the Sea, Montego Bay, done 10 December 1982, entered into force 16 November 1994; 1833 UNTS 3 & 1835 UNTS 261; UKTS 1999 No. 81; Cmnd. 8941; ATS 1994 No. 31; 21 ILM 1261 (1982); S. Treaty Doc. No. 103-39.

[20] *Cf. a contrario* Arts. 1, 2, Convention on International Civil Aviation, Chicago, done 7 December 1944, entered into force 4 April 1947; 15 UNTS 295; TIAS 1591; 61 Stat. 1180; Cmd. 6614; UKTS 1953 No. 8; ATS 1957 No. 5; ICAO Doc. 7300.

[21] Art. 11(1), Moon Agreement (*supra*, n. 9).

[22] Note that the Moon Agreement (*supra*, n. 9) itself, in Art. 11(5), (7) & (8), merely provides for the main principles and approach of such an international regime. See more in detail Tronchetti (*supra* n. 10), 788-92; R. Jakhu *et al.*, Article 11 (Common Heritage of Mankind/International Regime), in *Cologne Commentary on Space Law* (Eds. S. Hobe, B. Schmidt-Tedd & K.U. Schrogl) Vol. II (2013), 396-9.

to a quite detailed international regime dealing with exploitation, including requirements of obtaining an international license, technology transfer to less developed States and provisions ensuring some form of concrete benefit sharing[23]. (It was this corollary development of the concept of the 'common heritage of (hu)mankind' into quite some detail which played a major role in the lack of ratification of the Moon Agreement among industrialized nations, although it should be noted that also the developing countries refrained *en masse* from ratifying the Moon Agreement[24].)

On the other hand, the argument would run, if outer space would indeed qualify as a kind of 'global commons' this would mean that all States would be entitled to use resources for their own benefit (and, subject to the provisions of in particular Article VI of the Outer Space Treaty[25], allow their private sector to join in enjoyment of that freedom as well). The main fundamental limitations to the exercise of such a freedom in the context of natural resource exploitation (as well as in other contexts of course) would be compliance of relevant activities with applicable international law – meaning that a regime of *national* licensing would certainly be allowable, and there would be no prior requirement for an *international* licensing regime before any such exploitation would be allowed.

In this context, unfortunately, 'applicable international law' would be mainly limited to such general vague and broad principles stemming from the Outer Space Treaty as mentioned before: respect for the freedom of other States (as per Article I); prohibition of legal ownership of 'territory' (Article II); due regard requirements to try and avoid harmful interference (Article IX); the requirement of authorization and continuing supervision (Article VI); the acceptance of liabilities (Article VII, as elaborated by the Liability Convention[26] of 1972); and proper registration of space objects

[23] *Cf.* Arts. 133-191, United Nations Convention on the Law of the Sea (*supra*, n. 19); also Tronchetti (*supra* n. 10), 792-8.

[24] See in general Tronchetti (*supra* n. 10), 784-8; Von der Dunk (*supra* n. 3), 54-6.

[25] Art. VI, Outer Space Treaty (*supra*, n. 2), provides for an obligation of States to properly authorize and supervise private space activities qualifying as 'national', making the former internationally responsible for ensuring compliance of the latter with, strictly speaking, the Outer Space Treaty itself, and by inference and incorporation through Art. III, basically with all of international space law. See further Von der Dunk (*supra* n. 5), 50-5; M. Gerhard, Article VI, in *Cologne Commentary on Space Law* (Eds. S. Hobe, B. Schmidt-Tedd & K.U. Schrogl) Vol. I (2009), 106 *ff.*, esp. 116.

[26] Convention on International Liability for Damage Caused by Space Objects, London/Moscow/Washington, done 29 March 1972, entered into force 1 September 1972; 961 UNTS 187; TIAS 7762; 24 UST 2389; UKTS 1974 No. 16; Cmnd. 5068; ATS 1975 No. 5; 10 ILM 965 (1971). See further *e.g.* L.J. Smith, A. Kerrest de Rozavel & F.

involved in the operations (Article VIII, as elaborated by the Registration Convention[27] of 1975).

Interestingly, also here the law of the sea offered a corollary, in this case in the elaboration of the freedoms of the high seas in the absence of any possibility for individual States to exercise territorial jurisdiction over them: such freedoms notably include "(d) freedom to construct artificial islands and other installations permitted under international law, subject to Part VI; [and] (e) freedom of fishing, subject to the conditions laid down in section 2"[28].

2.4. *The relevance of the Moon Agreement in the context of Article II of the Outer Space Treaty*

Two further elements are noteworthy in the context of this discussion. As indicated, it has to be borne in mind here that while the Moon Agreement was ultimately considered unacceptable by the overwhelming majority of States because of the references to the 'common heritage of (hu) mankind', it also included a number of provisions which were viewed as mere elaborations of the Outer Space Treaty in the more specific context of celestial bodies, and hence as such had not given rise to much international discussion and disagreement.

First, precisely with a view to the discussion on the legality of lunar mining it is interesting to note that even the Moon Agreement

Tronchetti, The 1972 Convention on International Liability for Damage Caused by Space Objects, in *Cologne Commentary on Space Law* (Eds. S. Hobe, B. Schmidt-Tedd & K.U. Schrogl) Vol. II (2013), 83-226.

[27] Convention on Registration of Objects Launched into Outer Space, New York, done 14 January 1975, entered into force 15 September 1976; 1023 UNTS 15; TIAS 8480; 28 UST 695; UKTS 1978 No. 70; Cmnd. 6256; ATS 1986 No. 5; 14 ILM 43 (1975). See further *e.g.* B. Schmidt-Tedd et al., The 1975 Convention on Registration of Objects Launched into Outer Space, in *Cologne Commentary on Space Law* (Eds. S. Hobe, B. Schmidt-Tedd & K.U. Schrogl) Vol. II (2013), 227-324.

[28] Art. 87, United Nations Convention on the Law of the Sea (*supra*, n. 19). The reference to Part VI ensures that when it comes to the freedom to construct and use artificial islands and other installations for the purpose of exploiting resources residing in the Continental Shelf of a particular State, that State enjoys the exclusive rights to do so; *a contrario* elsewhere these rights are available to all States. Likewise, the reference to section 2 ensures that in the exercise of the freedom to fish anywhere on the high seas, the rules provided by the Convention on the conservation and management of the living resources of the high seas (and, by inference, other obligations under international law related to overfishing *et cetera*) are complied with; otherwise, that freedom is essentially unfettered.

refers to "natural resources *in place*" as being inappropriable by "any State, international intergovernmental or non-governmental organization, national organization or non-governmental entity or of any natural person"[29]. *A contrario* natural resources post-extraction should be considered appropriable at least in principle even without the international regime that the Moon Agreement calls for – in other words, the Agreement only legally precludes the possibility of 'reserving' a particular area on a celestial body for later exploitation with a State claiming it has the right to keep everyone else out, *not* the possibility of actually going to a particular area and exploiting its resources in accordance with normal commercial practices (and in compliance with international law, of course).

Certainly when it comes to undertaking legitimate activities in a particular area, actually the Moon Agreement, as a baseline, substantially condones them by providing for the right to "establish manned and unmanned stations on the Moon", as long as using "only that area which is required for the needs of the station"[30] – and as long as "they do not impede the free access to all areas of the Moon of personnel, vehicles and equipment of other States Parties"[31].

Second, it bears noting again that when the Moon Agreement calls for "an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the Moon as such exploitation is about to become feasible"[32], it only refers to the main purposes thereof:

(a) The orderly and safe development of the natural resources of the Moon;

(b) The rational management of those resources;

(c) The expansion of opportunities in the use of those resources;

(d) An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the Moon, shall be given special consideration.[33]

Nothing is provided, in other words, with regard to how elaborate or succinct such an international regime should be, and/or whether it indeed should include an international licensing scheme like that envisaged under

[29] Art. 11(3), Moon Agreement (*supra*, n. 9), emphasis added.
[30] Art. 9(1), Moon Agreement (*supra*, n. 9).
[31] Art. 9(2), Moon Agreement (*supra*, n. 9).
[32] Art. 11(5), Moon Agreement (*supra*, n. 9).
[33] Art. 11(7), Moon Agreement (*supra*, n. 9).

the United Nations Convention on the Law of the Sea for the deep seabed – instead of basically allowing for retention of national sovereign licensing authority.

Thus, also the set of treaty and other provisions addressing the use of radiofrequencies and orbits/orbital slots developed over three quarters of a century under the auspices of the International Telecommunication Union[34] would qualify as 'an international regime', even if they merely address coordination of the natural resources at issue here and harmful interference with the use thereof, and leave the authority of individual States to license commercial operators and operations in this realm – again, as long as complying with applicable international law – unabridged.[35] This is a clear corollary of the main thrust of Article VI of the Outer Space Treaty, calling for "authorization and continuing supervision" of space activities undertaken by "non-governmental entities" in order to ensure compliance with international space law.

2.5. *Towards authoritatively interpreting Article II of the Outer Space Treaty?*

Given all this, it would seem that the better legal interpretation of Article II of the Outer Space Treaty specifically in the context of celestial bodies' mineral resource exploitation would be the second one discussed above: of celestial bodies being part of a 'global commons' basically allowing for unilateral mining operations as long as compliant with any further applicable international law, and the prohibition on the exercise of property rights consequently being limited to the area as opposed to any resources extracted from it.

This interpretation would derive from the recognition that States are free to use outer space under Article I of the Outer Space Treaty unless specific applicable obligations under international law provide otherwise[36],

[34] See in detail F.G. von der Dunk, Legal aspects of satellite communications, in *Handbook of Space Law* (Eds. F.G. von der Dunk & F. Tronchetti)(2015), esp. 458-84.

[35] See further for this comparison Tronchetti (*supra* n. 10), 798-903.

[36] This is further in line with the so-called 'Lotus-principle', that "[i]nternational law governs relations between independent States. The rules of law binding upon States therefore emanate from their own free will as expressed in conventions or by usages generally accepted as expressing principles of law and established in order to regulate the relations between these co-existing independent communities or with a view to the achievement of common aims. Restrictions upon the independence of States therefore cannot be presumed."; The Case of the S.S. "Lotus" (Fr. v. Turk), Judgment, 1927 P.C.I.J.

that use has been commonly acknowledged to include commercial use[37], that Article VI of the Outer Space Treaty even allows for private – including commercial – space activities as long as compliant with applicable international law, and that stations and facilities on celestial bodies are also, in principle condoned[38].

Ultimately, however, the correct interpretation of Article II as a key clause of public international (space) law is not the prerogative of academic reasoning or argumentation. Articles 31 and 32 of the Vienna Convention on the Law of Treaties, generally acknowledged as presenting the authoritative approach to treaty-clause interpretation, only speaks of activities and actions of the "parties" to a particular convention, such as subsequent agreements among or instruments acknowledged by them on the matter[39]. Interpretations by individual experts would only play a role within the boundaries of what parties have more or less clearly agreed upon. More broadly, Article 38 of the Statute of the Court of Justice, widely recognized as authoritatively enumerating the main sources of international law in general, lists "the teachings of the most highly qualified publicists of the various nations, as subsidiary means for the determination of rules of law", 'subsidiary' here meaning secondary to international treaty law, customary international law and general principles of law[40].

(ser. A) No. 10, at 44. See also Von der Dunk (*supra*, n. 8), 102-3.

37 *E.g.*, the commercial use of space frequencies and orbital slots/orbits for telecommunication purposes has rapidly become a generally accepted, legally permissible use of such space resources, as long as operating within the broader remit of international law including the ITU regime as per the Constitution of the International Telecommunication Union, Geneva, done 22 December 1992, entered into force 1 July 1994; 1825 UNTS 1; UKTS 1996 No. 24; Cm. 2539; ATS 1994 No. 28; Final Acts of the Additional Plenipotentiary Conference, Geneva, 1992 (1993), at 1, as amended repeatedly; the Convention of the International Telecommunication Union, Geneva, done 22 December 1992, entered into force 1 July 1994; 1825 UNTS 1; UKTS 1996 No. 24; Cm. 2539; ATS 1994 No. 28; Final Acts of the Additional Plenipotentiary Conference, Geneva, 1992 (1993), at 71, as amended repeatedly; and the Radio Regulations, 2020; https://www.itu.int/en/myitu/Publications/2020/09/02/14/23/Radio-Regulations-2020 (last accessed 26 June 2024).

38 The only major limitation imposed by the Outer Space Treaty (*supra*, n. 2) concerns the prohibition of their military usage by Art. IV.

39 *Cf.* Art. 31(2), Vienna Convention on the Law of Treaties (*supra*, n. 18).

40 Art. 38(1)(d), Statute of the International Court of Justice, San Francisco, done 26 June 1945, entered into force 24 October 1945; 156 UNTS 77; USTS 993; 59 Stat. 1031; UKTS 1946 No. 67; ATS 1945 No. 1.

3. *National developments contributing to an interpretation of Article II of the Outer Space Treaty*

3.1. *Introduction*

Further to the above then, for the best indication of the proper interpretation of Article II reference should be had to the practice of States, both as "any subsequent practice in the application of the treaty which establishes the agreement of the parties regarding its interpretation"[41] and as the State practice (*usus*) which, if accompanied by *opinio juris*, could give rise to customary international law[42]. In a sense, these two methodological tools of analysis amount to the same: ultimately, the collectiveness of States determines the proper interpretation of a rule of international treaty law both as a matter of treaty interpretation under the Vienna Convention on the Law of Treaties and as a matter of customary international law narrowing down the scope of apparently legitimate interpretations of treaty clauses themselves still rather broad and vague.

From this perspective, the practice of States relevant for the discussion on the proper interpretation of Article II of the Outer Space Treaty effectively falls apart in two categories – *legal* practice and *political*, essentially non-legal yet potentially proto-legal practice.[43]

3.2. *Legal State practice: four national space laws*

As to legal State practice, so far four different States have established national space legislation in rather unequivocal terms allowing for the private sector to engage in celestial bodies' mineral resource exploitation as long as properly authorized and supervised in accordance with Article VI of the Outer Space Treaty, and already by that token as long as compliant with relevant international law. This should be interpreted as condoning, even confirming, an interpretation of Article II of the Outer Space Treaty

[41] Art. 31(3)(b), Vienna Convention on the Law of Treaties (*supra*, n. 18).

[42] *Cf.* Art. 38(1)b), Statute of the International Court of Justice (*supra*, n. 40).

[43] See also for a brief discussion on the complexities of 'State practice' in outer space, F.G. von der Dunk, International organizations in space law, in *Handbook of Space Law* (Eds. F.G. von der Dunk & F. Tronchetti)(2015), 307-9; on the role of customary law in space law *e.g.* B.D. Lepard, The Legal Status of the 1996 Declaration on Space Benefits: Are Its Norms Now Part of Customary International Law?, in *Soft Law in Outer Space* (Ed. I. Marboe) (2012), esp. 291-4.

as only precluding property rights over areas on celestial bodies as opposed to property rights over extracted mineral resources – otherwise, private sector mineral resource exploitation would simply be a non-starter.

Chronologically speaking the first to do so was the United States, with its adoption of the Commercial Space Launch Competitiveness Act[44] in 2015. Its Title IV deals with 'Space Resource Exploration and Utilization', and clearly recognizes property rights of US citizens and companies over space resources once mined on a 'first come, first served' basis – as for disputes under US jurisdiction, since obviously the United States cannot dictate how other States' courts would handle such disputes.[45] It also calls upon the US President to promote the interests of the US industry in this context internationally, suggesting the preference for development of some form of a general and 'light' international regime principally condoning private space mining operations under single-State licensing systems while calling for efforts to "discourage government barriers to the development in the United States of economically viable, safe, and stable industries" in this context[46].

Next, in 2017 Luxembourg adopted its Law on the Exploration and Use of Space Resources[47], which as the title indicates was even drafted specifically and exclusively with space mining in mind. It principally allows for private ownership over extracted resources, provides for a system of mission authorization for operators with Luxembourgish nationality and includes provisions regarding full liability for damage caused by such authorized operators[48].

In 2019 it was the turn of the United Arab Emirates to include,

---

[44] U.S. Commercial Space Launch Competitiveness Act; Public Law 114-90, 114th Congress, 25 November 2015; 51 U.S.C. 513. See further Von der Dunk (*supra*, n. 8), 111-4.

[45] Sec. 51302(a)(3) thus provides for "the right of United States citizens to engage in commercial exploration for and *commercial recovery of space resources* free from harmful interference, in accordance with the international obligations of the United States and subject to authorization and continuing supervision by the Federal Government"; emphasis added.

[46] Sec. 51302(a)(2).

[47] Law on the exploration and utilization of space resources (*Loi du 20 juillet 2017 sur l'exploration et l'utilisation des ressources de l'espace*)(hereafter Luxembourgish Space Resources Law); of 20 July 2017, published 28 July 2017; http://legilux.public.lu/eli/etat/leg/loi/2017/07/20/a674/jo (last accessed 24 June 2024). See further Von der Dunk (*supra*, n. 8), 114-7.

[48] See Arts. 1, 2, 3, 15, Luxembourgish Space Resources Law (*supra*, n. 47).

in its Law on the Regulation of the Space Sector[49], the possibility of obtaining, in conformity with further general provisions on the issue, an authorization "for the extraction, exploitation and utilization of space resources, including their ownership, purchase, sale, trade, transportation, storage and any Space Activities aimed at providing logistical services in this regard", subject to conditions yet to be determined[50].

And – so far – lastly, Japan adopted its specific Japanese Space Resources Act in 2021[51]. The Act establishes that a permit is required to pursue space resource extraction activities – in combination with a permit for launching an artificial satellite under the general Japanese Space Activity Act[52], for the purposes of which the applicant must provide amongst others information on satellite and launch-rocket designs, flight path, planned business activities and the purpose of the exploration and exploitation activities planned, as well as the timeframe, location and method[53].

From the perspective of customary international law of potential global applicability and authoritative interpretations of the relevant provisions of the Outer Space Treaty, it is noteworthy that two of the four national laws indeed specifically focus on space mining, whereas from another angle two of the four States concerned are major spacefaring nations while the two others by contrast do not belong to the traditional group of space powers. Also, so far no instances are known where States conversely have specifically prohibited commercial space mining operations from within their jurisdiction at least prior to any appropriate international regime. The States protesting against such commercial activities have so far done so in political terms and in a political context[54].

---

[49] Federal Law No. 12 of 2019 on the Regulation of the Space Sector (hereafter UAE Law on the Regulation of the Space Sector), of 19 December 2019; https://elaws.moj.gov.ae/UAE-MOJ_LC-En/00_SPACE%20SECTOR%20REGULATION/UAE-LC-En_2019-12-19_00012_Kait.html?val=EL1&Words=Space%20Agency#Anchor7 (last accessed 24 June 2024). See further Von der Dunk (*supra*, n. 8), 117-9.

[50] Art. 18, UAE Law on the Regulation of the Space Sector (*supra*, n. 49).

[51] Act on the Promotion of Business Activities for the Exploration and Development of Space Resources (hereafter Japanese Space Resources Act), Act No. 83 of 2021, of 23 December 2021; https://www8.cao.go.jp/space/english/resource/documents/act83_2021.pdf (last accessed 24 June 2024). See further Von der Dunk (*supra*, n. 8), 119-23.

[52] Act on Launching of Spacecraft, etc. and Control of Spacecraft, Act No. 76 of 2016, of 16 November 2016, entered into force 15 November 2018; https://www8.cao.go.jp/space/english/activity/documents/space_activity_act.pdf (last accessed 24 June 2024).

[53] See esp. Art. 3, Japanese Space Resources Act (*supra*, n. 51).

[54] *Cf.* F.G. von der Dunk, Asteroid Mining: International and National Legal Aspects, 26 *Michigan State International Law Review* (2017), 97-8.

At the same time, a number of four among close to two hundred sovereign States having thus expressed their unequivocal individual *opinio juris* is clearly insufficient to claim that their common denominator – commercial space mining and private ownership over extracted space resources for the purpose is, as such, in conformity with applicable international (space) law – indeed reflects customary international law.

3.3. *Political State practice: the Artemis Accords and related developments*

This is where discussion of some further political developments in the area, which could be viewed as proto-legal, becomes appropriate. Most notably, this concerns the Artemis Accords[55], a document drafted following US plans to land the first woman on the Moon[56] and beyond that develop long-term lunar human settlements, and to invite other States so interested to contribute to these plans with their technologies and funds.

The general idea of the Artemis Accords, "not eligible for registration under Article 102 of the Charter of the United Nations"[57] (which is generally interpreted as meaning that the Accords should not be viewed as a legally binding treaty), is to ensure that all States and their organizations involved in future Artemis projects are in agreement on a set of general principles underlying their common efforts, by defining object and purpose of the Accords as follows:

The purpose of these Accords is to establish a common vision via a practical set of principles, guidelines, and best practices to enhance the governance of the civil exploration and use of outer space with the intention of advancing the Artemis Program. Adherence to a practical set of principles, guidelines, and best practices in carrying out activities in outer space is intended to increase the safety of operations, reduce uncertainty, and promote the sustainable and beneficial use of space for all humankind. The Accords represent a political commitment to the principles described herein, many of which provide for operational implementation of important obligations contained in the Outer Space

[55] Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes (hereafter Artemis Accords), NASA, https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf (last accessed 24 June 2024). See further *e.g.* Von der Dunk, (*supra*, n. 8), 126-9.

[56] Note that in Greek mythology Artemis was the sister of Apollo, the US programme to land the first man on the Moon being named after the latter god.

[57] Sec. 13(2), Artemis Accords (*supra*, n. 55).

Treaty and other instruments.

The principles set out in these Accords are intended to apply to civil space activities conducted by the civil space agencies of each Signatory. These activities may take place on the Moon, Mars, comets, and asteroids, including their surfaces and subsurfaces, as well as in orbit of the Moon or Mars, in the Lagrangian points for the Earth-Moon system, and in transit between these celestial bodies and locations. The Signatories intend to implement the principles set out in these Accords through their own activities by taking, as appropriate, measures such as mission planning and contractual mechanisms with entities acting on their behalf.[58]

Most importantly for the present paper, the Artemis Accords in that context provide that the extraction and exploitation of space resources, including if feasible by commercial operators, seen as indispensable for developing long-term lunar habitation, should be in accordance with the Outer Space Treaty – meaning, that *as such* it is not considered to violate the latter: "The Signatories affirm that the extraction of space resources does not inherently constitute national appropriation under Article II of the Outer Space Treaty"[59]. While it is the intention of the signatories "to use their experience under the Accords to contribute to multilateral efforts to further develop international practices and rules applicable to the extraction and utilization of space resources, including through ongoing efforts at the COPUOS"[60], the principles of (private) ownership of extracted resources and attendant unilateral authorization are maintained as being in conformity with Article II and the Outer Space Treaty.

It bears noting, that as of this writing, the space agencies of 43 States have signed up to the Artemis Accords[61], and more importantly, from the perspective of potential customary international law and/or development of a potentially authoritative interpretation of Article II of the Outer Space Treaty, that these 43 comprise a large variety of States: major spacefaring nations as much as newcomers, major powers as well as small countries,

[58] Sec. 1, Artemis Accords (*supra*, n. 55).

[59] Sec. 10(2), Artemis Accords (*supra*, n. 55).

[60] Sec. 10(4), Artemis Accords (*supra*, n. 55).

[61] This concerns Angola, Argentina, Armenia, Australia, Bahrain, Belgium, Brazil, Bulgaria, Canada, Colombia, Czech Republic, Ecuador, France, Germany, Greece, Iceland, India, Isle of Man, Israel, Italy, Japan, Lithuania, Luxembourg, Mexico, the Netherlands, New Zealand, Nigeria, Peru, Poland, Romania, Rwanda, Saudi Arabia, Singapore, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Ukraine, the United Arab Emirates, the United Kingdom, the United States, Uruguay; see https://en.wikipedia.org/wiki/Artemis_Accords (last accessed 24 June 2024).

and countries from every corner of the globe – both Americas, Africa, the Arab world, Europe, Asia and the Australian continent.

Notably, the signatories to the Artemis Accords include no less than seven parties to the Moon Agreement[62]. Does this not mean somehow that, at least at a general level, those States do *not* consider underwriting the principles of the Artemis Accords on property rights to space resources to be in violation even of the clauses of the Moon Agreement referring to the common heritage of humankind and the need for an international regime requiring *inter alia* equitable sharing with special consideration for developing countries[63] – let alone as an incorrect interpretation of Article II of the Outer Space Treaty? Note that, all the same, so far one State has taken the (unprecedented) step of withdrawing from the Moon Agreement[64], and while Saudi Arabia has not publicly provided any reason for this withdrawal, it may be assumed that a perception of incompatibility of participation in the Artemis Accords with partisanship to the Moon Agreement played a major role in making the decision.

On the other hand, the lack of treaty-status of the Artemis Accords makes it rather unlikely that one could presently claim this widespread and rather rapidly growing 'adherence' as a form of State-practice-*cum-opinio-juris*. One has to realize that the Artemis Accords have not yet given rise to any actual landings, let alone further-reaching projects on the Moon, which means that all involved as of yet only have untested ideas about how actual landings, development of human habitation and lunar mining will work out; the Artemis principles are broad and general for a reason, the repeated references to further developments key to understanding the embryonic nature of whatever political and other consensus the Accords offer.

Furthermore, two major traditional space powers are notoriously missing from the list of Artemis Accords signatories – Russia and China[65]

[62] This concerns Armenia, Australia, Belgium, Mexico, the Netherlands, Peru and Uruguay; see Status of International Agreements relating to activities in outer space as at 1 January 2024; A/AC.105/C.2/2024/CRP.3*, of 15 April 2024; 5-9.

[63] See esp. Art. 11(7)(d), Moon Agreement (*supra*, n. 9).

[64] See U.N. Secretary-General, Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Saudi Arabia: Withdrawal, UN Doc A/AC.105/C.2/2022/CRP.10*, (Jan. 5, 2023); https://treaties.un.org/doc/Publication/CN/2023/CN.4.2023-Eng.pdf (last accessed 26 June 2024).

[65] It should be pointed out, that for political reasons – Russian and, slightly less, Chinese antagonism *versus* any US initiatives, given the present geopolitical climate – as well as more properly legal reasons – boycotts of Russia by the United States and its allies respectively US legislation making cooperation in this realm with China incredibly difficult if not downright impossible – any formal joinder by those two States to the Artemis program would so far seem to be out of the question.

– and without them, it would be difficult to claim global applicability of the Artemis principles on property rights over celestial bodies' resources and the attendant rights to exploit them commercially.

Interestingly however, within two years of the initial presentation of the Artemis Accords in 2020, in 2022 these two States initiated their own project for long-term human settlements and ensuing activities on the Moon: the International Lunar Research Station (ILRS) project.[66] As of this writing, nine more States have joined this particular project[67]. Ostensibly, the project focuses on exploration activities, but given the long-term focus of the project on utilization it is obvious that sooner or later principles, and then even rules, would have to be developed regarding the involvement of lunar mineral resources in such activities. It is noteworthy that the project has already contracted Western commercial companies as part of the ILRS project, and it will be interesting in this context to see to what extent principles substantially similar to those of the Artemis Accords would come to be developed[68]. To the extent that would be the case, it would of course hugely strengthen the argument that those principles, as then reflected in both the Artemis Accords and the ILRS documents, would serve at least as a baseline from which customary international law and an authoritative interpretation of Article II of the Outer Space Treaty would come to develop.

As a final point of note in this regard, it should be pointed out that, among other countries, China has concluded a bilateral agreement with Luxembourg on cooperation, which includes "economic, legal, regulatory and technological aspects of the utilization of space resources" and would also come to include the establishment of a Research Laboratory of Deep Space Exploration in Luxembourg together with the National Space Science Center of the Chinese Academy of Sciences[69]. This suggests that at least at the political level China has no unsurmountable problems with Luxembourg's role as one of the leading States developing law allowing for property rights over celestial resources and attendant rights to commercialize them.

[66] See also Von der Dunk (*supra*, n. 8), 129-30.

[67] This concerns Azerbaijan, Belarus, Egypt, Nicaragua, Pakistan, Serbia, South Africa, Thailand and Venezuela; see https://en.wikipedia.org/wiki/International_Lunar_Research_Station (last accessed 24 June 2024).

[68] See https://en.wikipedia.org/wiki/International_Lunar_Research_Station (last accessed 24 June 2024).

[69] See Luxembourg and China Agreed to Cooperate on Space Exploration, LUX. TRADE & INVEST (17 January 2018); https://www.tradeandinvest.lu/news/luxembourg-china-sign-agreement/ (last accessed 26 June 2024).

4. *Concluding remarks*

The prospects for a peaceful and generally beneficial exploitation of celestial bodies' mineral resources to a major extent depend on a globally acceptable and acknowledged legal regime addressing property rights over such resources. It should by now be clear that such a regime is presently absent to any appreciable extent, which in turn means that its future development will depend to a major extent on whether Article II of the Outer Space Treaty and its prohibition of national appropriation of (parts of) celestial bodies will come to be interpreted in a more or less uniform manner by all States concerned, taking other key provisions of the Outer Space Treaty such as the baseline freedom of activities on celestial bodies including the establishment of stations and facilities, the freedom of access to all areas of celestial bodies, and the requirements pertaining to due regard, sustainability and liability for damage into account.

The formal establishment of national legislation by four States unequivocally allowing for commercial exploitation of celestial bodies' mineral resources by recognizing the possibility of property rights thereover once extracted and the adherence by more that fourty national space agencies and their States to the same principle by way of signing up to the – non-legally binding – Artemis Accords are, in and of, themselves insufficient to conclude that this has already become customary international law. As to the former, 'four' is to small a number; as to the latter, the principle is as of yet too broad and, more importantly, as of yet untested by the reality of undertaking mining operations on celestial bodies, to be qualified as a *legal* principle in this context.

At the same time, the continuously and rapidly growing number of States and their space agencies to the Artemis Accords, especially given the broad variety of nations concerned, suggests that, once such mining operations would come to be a reality, the Accords would indeed present the most likely baseline for the development of true legal principles, and then rules, on the issue. Much will also depend on the details of the ILRS project's approach to exploitation of celestial bodies' natural resources, Russia and China being the two most important space powers so far not having clearly spoken out either in favour of the relevant Artemis principle, or – at least more recently, given the initial strong negative responses on the part of the Russian Federation – against it. Interestingly, as indicated, China has actually engaged in fundamental collaboration with Luxembourg, one of the four States that have through their national space law spoken out clearly in favour of that principle.

Similarly interestingly, the initiative of NASA to task a Japanese company, iSpace, with gathering lunar regolith, followed by a license for iSpace under the Japanese Space Resources Act[70], has so far generated fairly little controversy in terms of a serious discussion regarding its potential legality or illegality.

Crystal balls are obviously not available with regard to the future of space mining, but if the above indications mean anything, the more likely outcome of these developments would be, perhaps within the next five to ten years, a globally accepted recognition of the possibility to obtain legally binding property rights over mineral resources extracted from celestial bodies so as to allow truly commercial exploitation to be initiated as a proper principle of customary international law.

What remains then, is for the international community to ensure that such commercial exploitation would not result in utter neglect of the valid overriding interests of the public at large in safe, secure and sustainable development of activities on celestial bodies, with due regard for their nature as being a 'global commons' and such exploitation generally being the province of all humankind[71].

[70] See https://ispace-inc.com/news-en/?p=3829 (last accessed 27 June 2024).

[71] *Cf.* Art. I, Outer Space Treaty (*supra*, n. 2), stating that "exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind".

Antonia Eliason

Corporations and Outer Space: Strong Legal Foundations

Summary: 1. Introduction – 2. The theoretical framework: corporate roles in international lawmaking – 3. Space law: exception or norm in rulemaking? – 4. Space law and the theoretical framework – 5. Environmental engineering: a legal void – 6. Conclusion.

1. *Introduction*

Corporations lie at the heart of the development and governance of modern space law. In this respect, space law is not that unusual in the realm of international law. International investment law, for instance, deals with issues of foreign investment in many sectors, including space. Trade law covers many aspects of space technology. Corporations play significant roles in both of these areas of international law, both as active dispute settlement participants in the case of investor state dispute settlement (ISDS) and as participants in bringing trade actions to the attention of national authorities, as well as in their lobbying capacity. This chapter provides a theoretical framework for understanding the increased role of corporations in international lawmaking, discussing how space law fits in that framework and arguing that space law is an area where lawmaking is in fact more conventional than in some other cutting-edge areas of technology. Not all areas of space law operate in a conventional manner, however. Space-based environmental engineering is an area where regulatory reform is needed, and where the lack of regulations allows corporations and individuals to act in a relatively unrestrained manner.

2. *The theoretical framework: corporate roles in international lawmaking*

The topic of corporate involvement in developing international law has been of great interest to academics and policy-makers.[1] In a recent article, I examine the role that corporations play in international lawmaking broadly, shining a light on the undertheorized question of why corporations are finding themselves in the position of becoming international lawmakers and norm-setters.[2] I argue that the main reasons for the increasing lawmaking involvement of corporations is threefold:

1. Law is generally reactive, not proactive, providing ex post rather than ex ante solutions. Particularly in areas involving cutting edge technological developments, a lack of legal regulation has put corporations in the position of lawmakers.
2. International law is becoming increasingly contractualized, multilateral treaties giving way to bilateral and regional agreements whose structures more closely resemble those of contracts, which are the modus operandi of corporations.
3. The financialization of corporations, and the consequent prioritization of shareholders over customers and workers, incentivizes corporations to shape the law in their favor.

This theoretical framework informs the challenges that exist in developing rules for conduct in outer space, but as this chapter will examine more closely, space law is something of an outlier in the corporatization of international law, because unlike most areas of law, it has its origins in an effort to create law proactively. This is not, as we will see, the case for environmental engineering, the possibility of which was not conceptualized in space law treaties, and which poses a real threat to our planet's future if not properly regulated. Existing rules that could apply to space-based environmental engineering are currently inadequate.

[1] *See, e.g.*, F. Mégret, *Are There "Inherently Sovereign Functions" in International Law?*, 115 *Am. J. Int'l L.* 452 (2021), and the 2021 AJIL Unbound symposium reflecting on this article; M. J. Durkee, *Interstitial Space Law*, 97 *Wash. U. L. Rev.* 423 (2019); M. J. Durkee, *The Business of Treaties*, 63 *UCLA L. Rev.* 264 (2016); J. Arato, *Corporations as Lawmakers*, 56 *Harv. Int'l L. J.* 229 (2015; G. C. Shaffer, *How Business Shapes Law: A Socio-Legal Framework*, 42 *Conn. L. Rev.* 147 (2009); A. C. Cutler, *Ideology and Paradox: The Public/Private Distinction in International Law*, 4 *Rev. Int'l Pol. Econ*. 261 (1997).
See also D. Lustig, *Veiled Power: International Law and the Private Corporation, 1886-1981* (2020).

[2] A. Eliason, *International Law by Corporation*, *87 Albany L. Rev. 127* (2024).

3. *Space law: exception or norm in rulemaking?*

This chapter looks at space law as a frequently cited example of a legal environment where corporations are heavily involved. Scholars and policy-makers have raised concerns regarding the ways in which corporations are changing the interpretation of the Outer Space Treaty[3] and pushing for legal and regulatory environments that are more favorable to corporate interests.[4] The shift from multilateral treaties to soft law accords such as the Artemis Accords feeds this perspective.[5] This is viewed, depending on who is analyzing it, as either an important step in the commercialization of outer space, or something novel and frightening, an example of dangerous corporate intervention in international lawmaking. The Artemis Accords, a U.S.-driven non-binding instrument, has gained rapid acceptance in the international space community, with forty-three countries having signed on to it as of the time of the chapter's writing.[6] Rather than operate on a multilateral basis, like the Outer Space Treaty or Liability Convention, the Artemis Accords are a series of agreements between the United States and other countries. While there is an aspect of contractualization of international law to these, in the bilateral nature of the accession to the accords which are a product of United States foreign policy rather than multilateral negotiation, their non-binding nature pulls the Accords out of the realm of traditional contract-making.

Space policymaking in the United States involves constituents from different sectors, including industry. The National Space Council, which was revived during the Trump Administration in June 2017, highlighted the need for US space leadership in order to maintain US national security.[7] The Council's Users' Advisory Group membership includes

[3] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

[4] See, e.g., G. D. Kyriakopoulos, *Positive Space Law and Privatization of Outer Space: Fundamental Antinomies*, in The Space Treaties at Crossroads: Considerations de Lege Ferenda (G. D. Kyriakopoulos & M. Manoli eds., 2019).

[5] NASA, The Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes (2020) [hereinafter Artemis Accords], https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf.

[6] The Artemis Accords, NASA, https://www.nasa.gov/artemis-accords/.

[7] N. Riordan, M. Machoň, L. Csajková, Space Diplomacy and the Artemis Accords, 49 The Hague Journal of Diplomacy 1 (2023), 7.

industry representatives as well as academics and aerospace experts. This group has played a key role in advising on national space policy, reflecting the balance of interests that make up the contemporary landscape of space exploration.[8]

Despite the current focus on the Artemis Accords as the future of law-making in the space arena, space law is arguably one of the more traditional legal disciplines, insofar as the existing treaty regime remains central to much of the discussion regarding how to conduct private space activities. While there has been much discussion of how the provisions of the Outer Space Treaty might apply to commercial space activity,[9] states have not as of yet reneged on the core provisions of the agreement. National legal systems have implemented regulations that allow corporations to pursue their commercial goals, while providing oversight of such space activity.[10] Far from violating the principles of the Outer Space Treaty, such regulations are in compliance with Article VI of the Outer Space Treaty, which expressly provides for state responsibility for activities by non-governmental entities.[11] The challenge with Article VI is that the rest of

[8] Riordan, Machoň, Csajková, 7.

[9] See, e.g., M. Lucas-Rhimbassen, L. Rapp, L. Mallowan, Uncommon Commons, Commodities and Tokens in Outer Space: A Critical Viewpoint on New Competition Issues, 19 Astropolitics 116 (2021); A. J. Harrington, Space Insurance and the Law: Maximizing Private Activities in Outer Space (2021); B. J. Egan, The Next Fifty Years of the Outer Space Treaty, Remarks, Galloway Symposium on Critical Issues in Space Law, December 7, 2016.

[10] F. Tronchetti, H. Liu, The White House Executive Order on the Recovery and Use of Space Resources: Pushing the Boundaries of International Space Law?, 57 Space Policy 1 (2021). Besides the United States, Luxembourg, the United Arab Emirates and Japan have implemented their own national legislation on the commercial use of space. India implemented a space policy in 2023 that includes NewSpace India Limited, a public sector undertaking under the Department of Space that will be "responsible for commercialising space technology and platforms created through public expenditure." (Indian Space Policy, 2023)

[11] Outer Space Treaty, art. VI:
States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the Moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization.

the Outer Space Treaty was designed with purely state activities in mind, thus leaving a variety of gaps that have given rise to questions as to how the overall regime should apply to private entities.[12]

Where some scholars have exceptionalized space law as an area of particular corporate influence in international law-making,[13] the nature of space flight, at least currently, necessitates governmental involvement, thus creating a space where core legal texts are being interpreted by states as well as non-state actors, highlighting the centrality of these texts to the legal regime of outer space. From launch approvals to financing, governments still play a crucial role in space activities, even where corporations are taking the lead at commercialization efforts.[14] The development of national space legislation reflects the engagement of corporations in negotiations and lobbying effort, but this is not unique to space law, nor even to international lawmaking in the 21st century. In trade law, for instance, corporations influence government decision-making, their lobbying impacting what areas governments prioritize for negotiations.[15] Regulators rely on knowledge production by specific interest groups, who generate the data that is subsequently relied on by regulators in setting policy.[16]

Space law as a broad field is arguably an area of law that is seeing more conventional development than other rapidly developing areas of law, notably artificial intelligence and cybersecurity which lack any existing legal infrastructure that adequately captures the complexities of these burgeoning areas of technology. The commercialization of outer space appears to be a more traditional example of the intermingling of corporate and state interests. This is not just a recent development. Although the driving forces behind the Outer Space Treaty were Cold War fears concerning security and the risk of the weaponization of outer space,[17]

[12] P. J. Blount, Renovating Space: The Future of International Space Law, 40 Denv. J. Int'l L. & Pol'y 515 (2011), 518.

[13] See, e.g., Durkee, Interstitial Space Law, 428.

[14] See C. Stotler, *What is NewSpace?*, in NewSpace Commercialization and the Law (Md T. Ahmad, J. Su, eds.), 2017 for a discussion of what commercialization in space in a contemporary context looks like.

[15] W. Y. Li, *Regulatory Capture's Third Face of Power*, Socio-Economic Rev. 1 (2023). *See also* D. Dayen, *Big Tech Lobbyists Explain How They Took Over Washington*, The American Prospect, April 18, 2023, https://prospect.org/power/2023-04-18-big-tech-lobbyists-took-over-washington/.

[16] Li, 7.

[17] F. G. von der Dunk, Property Rights over the Moon or on the Moon?: The Legality of Space Resource Exploitation on Celestial Bodies, 6 J. L. & Innovation 95 (2003), 98.

the negotiating history of the Outer Space Treaty shows that the United States has contemplated private exploration and use of outer space since the very outset of the space age.[18] In the negotiation of UNGA Resolution 1962 (XVIII): Declaration of Legal Principles governing the Activities of States in the Exploration and Use of Outer Space, which was adopted on December 13, 1963, and which preceded the adoption of the Outer Space Treaty, the Soviet Union wanted activities in space to be exclusively carried out by states. The United States disagreed with this position, since it was already planning to launch privately-operated telecommunications satellites.[19] The eventual text of the UN Resolution adopted language regarding state responsibility for non-governmental entities that became Article VI of the Outer Space Treaty. As previously mentioned, Article VI expressly contemplates activities by non-governmental activities and provides for state responsibility for such activities, reflecting the position taken by the United States in the negotiations, and opening the door to the commercialization of space.

Viewing the actions of private entities in relation to the commercialization of outer space as an outlier or as the vanguard of a new and troubling trend diminishes the role that capitalist values play in dictating the principles that the United States has long espoused both in domestic legislation and in international rule-setting, and that other countries have also embraced. The commercialization of space is in some ways the final frontier of capitalist extraction—as of yet untapped, and ripe for exploitation. It is no wonder that national governments and corporations are both interested in furthering opportunities for commercial development in space. In terms of space law, the 1960s were about national security through preventing extra-terrestrial territorial grabs and the weaponization of outer space. The 2020s are about national security through space-based private sector-driven resource exploitation.

The greatest disagreements over the merits of the current space law regime relate to the Moon Agreement,[20] which almost no one would have argued even twenty years ago was an example of a successful international treaty, as well as to core provisions of the Outer Space Treaty that contain

[18] M. Gerhard, *Article VI*, Cologne Commentary on Space Law, Volume 1: Outer Space Treaty, 105, in relation to the negotiation history of Article VI of the Outer Space Treaty in particular.

[19] Gerhard, 105.

[20] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 5, 1979, 1363 U.N.T.S. 3 (entered into force July IH, 1984) [hereinafter Moon Agreement].

within them ambiguities.[21] The Moon Agreement, which was never ratified by any country with space flight capabilities, and which currently has only seventeen parties, is largely irrelevant as an international law instrument to all but a few countries, despite there being a significant amount of discussion surrounding its provisions, particularly the language concerning the common heritage of mankind.[22] For Australia, Mexico and the Netherlands, which are parties to both the Moon Agreement and the Artemis Accords, a possibility of conflict between the Accords and the treaty provisions of the Moon Agreement exists. Additionally, with the immediate commercialization of outer space centering around the extraction of resources from the moon, the attention paid to the Moon Agreement is understandable.

The interpretation of provisions of the Outer Space Treaty, unlike disagreements over the applicability of the Moon Agreement are more firmly rooted in international law and add fuel to the argument that rather than being an example of lawmaking that is occurring outside the confines of traditional public international law, the development of contemporary space law is in fact a very traditional manifestation of international lawmaking, not unlike what we see in the trade law sector. What, if not an exercise of traditional public international law, is the interpretation of treaty ambiguities such as those found in the Outer Space Treaty? After all, these are not efforts to bypass or ignore the treaty, but rather to find a way to uphold the core tenets in a way that facilitates corporate involvement in outer space, something that itself is far from new in the space sector, and that dates to the earliest efforts to launch commercial satellites. The Artemis Accords explicitly refer to upholding the principles of the Outer

[21] What "continuing supervision" means in the context of Article VI of the Outer Space Treaty is a point of significant legal contention. See Harrington, 140.

[22] Moon Agreement, Article 11(1): "The moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this Agreement, in particular in paragraph 5 of this article." For discussion regarding the Moon Agreement in academic scholarship, see, e.g. M. Lucas-Rhimbassen, *On the Province of All Marskind*, in Assessing a Mars Agreement Including Human Settlements (Annette Froehlich ed. 2021), 33; R. S. Jakhu, J. N. Pelton, Y.O.M. Nyampong, Space Mining and Its Regulation (2017), 130. S. Atkins, *Governance in Outer Space: The Case for a New Global Order*, Norton Rose Fulbright, Nov. 2022, 5, points out that the Artemis Accords does not mention the Moon Agreement, which represents a shift away from the global commons approach. Melissa Durkee, in *Interstitial Space Law*, 459-460, suggests that the rejection of the Moon Agreement's principles by states, particularly those with space programs, is itself subsequent practice that could be used to help interpret provisions of the Outer Space Treaty.

Space Treaty, reminiscent of the ways in which (admittedly binding rather than non-binding) bilateral and regional trade agreements between states recognize the applicability of the World Trade Organization's rules.[23]

4. *Space Law and the theoretical framework*

If we understand law and regulation in the context of space as an exercise of traditional lawmaking functions, then it helps us view the roles played by private entities through that lens. Where then does the initial theoretical framework regarding corporate roles in international lawmaking fit with respect to the space sector? Here, I briefly examine each of the key reasons for the corporatization of international law and how this applies to the space sector.

As this chapter initially posited, one reason for the increased role of corporations in international lawmaking broadly is the reactive nature of most laws – the *ex post* rather than *ex ante* nature of how we develop regulations – and the consequent lack of regulation that offers corporations a way to help shape the formation of new laws.[24] In this respect, space law is a little bit of an outlier, representing perhaps one of the rare examples of *ex ante* lawmaking. The Outer Space Treaty was proactive in anticipating the possibility of space exploration, providing rules that would apply in the future to situations that were not yet technologically feasible (and that in many cases are still not yet technologically feasible). Space law is not so much struggling to catch up with developments in space exploration and exploitation, but rather space exploration/exploitation is developing within the framework of a pre-existing legal regime, which did not answer all the questions that we are faced with today, including, notably, the question regarding ownership of space resources.

---

[23] Artemis Accords, Section 10(2): "The Signatories emphasize that the extraction and utilization of space resources, including any recovery from the surface or subsurface of the Moon, Mars, comets, or asteroids, should be executed in a manner that complies with the Outer Space Treaty and in support of safe and sustainable space activities."

[24] *See, e.g.*, S. Shlomo-Agon, M. Saliternik, *Proactive International Law: Keeping Pace with an Accelerated World*, Verfassungsblog, Aug. 14, 2022, https://verfassungsblog.de/proactive-international-law/; L. Burton, M. J. Egan, *Courting Disaster: Systemic Failures and Reactive Responses in Railway Safety Regulation*, 20 Cornell J. L. & Pub. Pol'y 533 (2011), discussing the case of reactive reregulation in response to deregulation, where regulation only occurs in the wake of tragedies.

The uniquely proactive nature of space law from its inception has given rise to the heated discussions that we are currently seeing around the role of corporations in space exploration/exploitation. In most other areas where companies are shaping rules around new technologies, such as artificial intelligence, cryptocurrency or social media, the law comes late to the game, responding to corporate action already taken. In these contexts, corporations create the ground rules that laws only later codify with attempts to limit worst case legal scenarios. Discussions concerning the role of corporations in these sectors are largely moot.

With outer space, international lawmaking was *ex ante*, created decades before commercial space exploration was viable, and now corporations are running up against interpretive questions in decades-old treaties, leading some to (incorrectly) call these treaties obsolete. A better analogy for this situation than newer technology sectors such as those described above might be a telecommunications company with a new technological development running up against regulations that were designed for an older technological milieu.

Returning to the theoretical framework, the second main point is that that private entities are increasingly significant in space lawmaking space due to the de-multilateralization of international law (as we move towards more contractual models of forming agreements). Currently, we are simply not in an age of multilateralism, and while to some this marks a troubling departure from the established norm, in the broader historical context, multilateralism has been a brief part of the history of international treaty negotiation. The age of multilateralism spanned a period of five or so decades post-World War II, arguably ending with the last great multilateral accomplishment—the creation of the World Trade Organization in 1995.[25] The international treaty regime is returning to a more regional approach to negotiating agreements. From space law to trade law, whether it is a China/Russia alignment or a United States/Europe alignment, geopolitics and regional agreements are the future. The role of corporations in this kind of negotiation framework is significant, with practical commercial decisionmaking gaining an upper hand over more idealistic rulemaking such as those found in multilateral treaties such as the International Covenant on Civil and Political Rights and the International Covenant on Economic, Social and Cultural Rights.[26]

[25] The Uruguay Round of negotiations, which resulted in the creation of the World Trade Organization in 1995 was a culmination of neoliberal economic ideologies and policies.

[26] International Covenant on Civil and Political Rights, Adopted by the General Assembly of the United Nations on 19 December 1966; International Covenant on Economic,

The third piece of the theoretical framework is that the financialization of our economy and the consequent prioritization of shareholders over laborers and consumers has driven the influence of corporations in international lawmaking. This is as true in the space sector as in any other sector—the drive to produce profit guides much of the decision making, both at the national level and from the private sector, which actively lobbies national lawmakers. International law has, for the most part only accounted for individuals in the context of human rights, which has been a product of post-war multilateralism. As our domestic economic priorities have continued to shift away from individuals and the idea of a state based on key principles of social welfare—away from the notion of embedded liberalism espoused by John Ruggie, corporations have regained much of the power that they once wielded over government actors and institutions.[27]

In sum, what is happening in space law is not the anomalous outlier of private sector activity that some parties argue. In the ways in which corporations are articulating their rulemaking or rule-influencing capacities in setting the regulatory agenda, they are in fact, unusually, responding to a pre-existing legal regime that they view as inadequately fitting their needs. As the next section will explore, however, while this is true for more traditionally conceived aspects of space exploration/exploitation, it is not for other, more novel sectors within the broader purview of space-based activity.

5. *Environmental engineering: a legal void*

Not every realm of space and space-adjacent activity operates in the more conventional fashion laid out in the preceding sections of the chapter. Environmental engineering, or geoengineering, poses particular challenges due to the lack of applicable regulation and the broad range of measures falling under its scope. Due to the potential irreversible consequences of such environmental engineering, there is a certain urgency to the need for legal regulations. For purposes of this chapter, environmental engineering as discussed here is limited to solar radiation management

Social and Cultural Rights. Adopted by the General Assembly of the United Nations on 16 December 1966.

[27] J. G. Ruggie, International Regimes, Transactions, and Change: Embedded Liberalism in the Postwar Economic Order, 36 *International Organization* 379 (1982).

(SRM), which is where space and space-adjacent activities are implicated.[28] In SRM, methods are employed to increase surface and cloud albedo, or stratospheric aerosols are injected or space reflectors are installed.[29] These mechanisms are designed to reduce the sun's effect on earth. The biggest concern with SRM is the unintended consequences that may arise, and the possibility of termination shock if the mechanisms cease to function, resulting in a dramatic increase in temperature, particularly where CO_2 emissions continue to rise during the time the SRM is deployed.[30]

While space-based environmental engineering may seem farfetched and thus not of immediate concern, discussions of such technologies have moved from the fringes of technological magazines to mainstream news sources. In February 2024, the New York Times ran an article about solar radiation management in the form of a proposal to launch a giant solar parasol to block just under two percent of the sun's radiation, which could potentially cool the planet by 1.5 degrees Celsius.[31] The solar parasol is so huge and costly that even with significant national financial investment, it currently seems farfetched, but only insofar as the global defense spending on developing weapons is farfetched. The trillions of dollars needed to develop and deploy such a solar parasol is farfetched for most projects that are not defense-related, but as the climate crisis grows more severe, solutions perceived as quick-fix technological solutions will inevitably become more desirable to many government officials and policy-makers. The proliferation of discussion regarding the viability of geoengineering measures reflects growing concerns regarding the effects of climate change and our failure to take significant actions to mitigate it.

Due to the relative ease with which corporations and even wealthy individuals could take unilateral action with respect to environmental engineering, the lack of regulation in this sphere is troubling. Corporations in this

[28] G. Winter, *Climate Engineering and International Law: Final Exit or the End of Humanity?*, in Climate Change: International Law and Global Governance, vol. I: Legal Responses and Global Responsibility 979, 981-982 (O. C. Ruppel, C. Roschmann, K. Ruppel-Schlichting eds., 2013), discussing how large scale carbon dioxide removal efforts are known as Carbon Dioxide Removal (CDR), while increasing surface and cloud albedo is known as Solar Radiation Management (SRM).

[29] Winter, 982.

[30] NAT'L RSCH. COUNCIL OF THE NAT'L ACADS., Climate Intervention: Reflecting Sunlight to Cool Earth (2015), 65.

[31] C. Buckley, Could a Giant Parasol in Outer Space Help Solve the Climate Crisis?, February 2, 2024, The New York Times, https://www.nytimes.com/2024/02/02/climate/sun-shade-climate-geoengineering.html.

area exist largely outside the realm of current regulation, yet as the climate crisis worsens, the possibility of unilateral geoengineering efforts increase. What is of gravest concern is the likelihood that such action, with possible irreversible effects on the planet, could be taken by a wealthy individual or a private corporation, and in this respect, the legal regime is inadequate in responding to the challenge. This area of lawmaking, as with AI or other cutting-edge technologies, has not been thoroughly conceptualized.

The Outer Space Treaty and the Liability Convention do provide some measure of legal protection that would likely apply to SRMs. Article VII of the Outer Space Treaty, which itself gave rise to the Liability Convention, ascribes liability to the launching state for damage caused by its space objects, holding that each state party to the treaty "that launches or procures the launching of an object into outer space … is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air or in outer space."[32] The Liability Convention, in turn makes launching states "absolutely liable to pay compensation for damage caused by its space object on the surface of the Earth or to aircraft flight."[33] The challenge with the applicability of the Liability Convention is that it appears to be focused on physical damage caused by space objects, and is less clear as to whether it would apply to effects caused indirectly by space objects. Looking at space reflectors, like the proposed solar parasol, it would not be the solar parasol itself that would cause damage to the Earth, but rather the effect of parasol that would partially blocking the sun and potentially have unintended negative consequences caused by that indirect effect.[34]

The strict liability standard in the Liability Convention reflects the very real concern regarding the possibility of space objects causing harm to humanity. Environmental engineering was definitely not in the realm of the possible or even foreseeable at the time of its drafting. and it is possible that their intention would have extended to include indirect damage where the "but for" cause was the deployment of the space object in question, despite the space object not being the primary physical actor in causing the damage. Even if the Liability Convention is of limited applicability in the case of environmental engineering, it can serve as a

[32] Outer Space Treaty, Article VII.

[33] Convention on International Liability for Damage Caused by Space Objects art. II, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention].

[34] A. Eliason, Avoiding Moonraker: Averting Unilateral Geoengineering Efforts, 43 U. Pa. J. Int'l L. 429, 449.

model for an international liability regime that would be applicable to environmental engineering more specifically.[35] The Liability Convention's liability regime is unique in international law as the only example based entirely on state liability.[36] Imposing strict state liability on environmental engineering could provide an avenue for states to take a more proactive role in holding corporations and individuals responsible for environmental engineering efforts that they engage in. The long arm of international law does not work effectively to control the behavior of private parties—state intervention offers the best option to de-incentivize reckless behavior.

With soft law playing an important role in the development of space law, some parties advocate for this as the best solution for the gradual creation of binding international law norms in a rapidly developing field such as environmental engineering. The Artemis Accords, for instance, represent the most ambitious effort to develop multilateral principles through a soft law vehicle. Yet soft law is only as effective as the willingness of parties to abide by it, and when corporations are brought into the mix, their adherence to voluntary norms such as corporate social responsibility standards is often superficial at best and deceptive at worst.

Recent ESG laws in Europe offer binding mechanisms that offer the promise of holding corporations responsible for their actions, particularly with respect to climate change and sustainable development. In the field of environmental engineering, ESG laws could provide a deterrent to unilateral corporate action, however they fail to address the risks of a corporation acting first and asking for forgiveness later. Ultimately, there is no single solution to address the risks of environmental engineering, and particularly the possibility of corporate action that jeopardizes our planetary wellbeing. As with any large scale legal endeavor over something that is itself somewhat amorphous and difficult to pin down concretely, particularly as the technologies available to deploy will change, a multipronged approach is necessary. This includes multilateral negotiations and domestic legislative efforts to address the risks before irreversible actions are taken. Drawing on the close relationship between traditional space law and national security, the importance of combining traditional strategies involving high-level negotiations with more cutting-edge legal mechanisms such as ESG laws is necessary.

[35] T. Hester, Liability and Compensation, in Climate Engineering and the Law: Regulation and Liability for Solar Radiation Management and Carbon Dioxide Removal 224, 249 (Michael B. Gerrard & Tracy Hester eds., 2018).

[36] J. B. Horton, A. Parker, D. Keith, Liability for Solar Geoengineering: Historical Precedents, Contemporary Innovations, and Governance Possibilities, 22 N.Y.U. ENV'T. L.J. 225, 233-34 (2015).

6. *Conclusion*

In 1958, Myres McDougal and Leon Lipson published a seminal article, *Perspective for a Law of Outer Space* in the American Journal of International Law, in which they argued that while space law could occur through explicit and formal agreements, it could also occur through "a consensus achieved by the gradual accretion of custom from repeated instances of mutual toleration."[37] As McDougal and Lipson pointed out, "details and sequence [of the agreements] must, like much else in an indeterminate universe, depend on the order of experience in space as well as on the changing political context."[38] Today, we are closer to the possibility of true commercialization of outer space than ever before, and certainly than could have been contemplated by the original negotiators of the outer Space Treaty. Space-based environmental engineering, which was not even a glimmer on the horizon for early space law and policy experts, is also closer each day to becoming a reality.

There is more hope for a rules-based international space commercialization regime than there is for a robust legal regime that will govern environmental engineering in time to prevent unregulated and possibly irreversible actions from taking place. The *ex ante* space law regime provides a strong bedrock of core principles that are generally accepted by the big players on the international scene and that have informed the development of national legislation. The absence of a legal regime for environmental engineering, on the other hand, other than the applicability of Article VI of the Outer Space Treaty to the actions of non-governmental entities in outer space and the possibility of the Liability Convention applying to indirect damage by space objects, provides a dangerous void in which anything is possible for a motivated private actor, and which is not currently a focus of national and international attention in the way that commercialization of outer space is.

[37] M. S. McDougal, L. Lipson, *Perspectives for a Law of Outer Space*, 52 Am. J. Int'l L. 407, 430 (1958).
[38] McDougal, Lipson, 430.

Marco Falcon

Roman Law Perspectives in Space Law[1]

Summary: 1. The legal regime of space between international and Roman law – 2. Some questions – 3. *Res communes omnium* in Roman law – 4. Conclusive remarks.

1. *The legal regime of space between international and Roman law*

For evident reasons, Romans had no space discipline as we think of it today, *i.e.* as a set of rules regulating space and outer space activities: the 'Roman Perspectives' are in fact more a kind of 'retrospective thoughts' on space law, and in particular on the 1967 Outer Space Treaty, concerning outer space, the Moon and other celestial bodies.

In dealing with this topic, I will leave aside some general problems that could be addressed in the use of Roman categories in current law: for example, I will not confront the problem of the alterity between States – main characters of international law – and private persons – the only ones taken into consideration by Roman law in the field we will focus on.

As is well known, with the first space explorations the question arose of what should the regime of space and its content be, namely the regime of celestial bodies and, in a position that has always been special, of the Moon.

The answers initially varied[2], but they were all based on principles that, in one way or another, went back to Roman law, often recalled as a traditional source of principles of international law.

Abandoning the idea that state sovereignty (and so *lato sensu* ownership)

[1] The text of the speech has been enriched with some notes referring to the key bibliography. In general, the paper has developed along the lines of M. Falcon, *Some Remarks on* Roman Space Law, in M. Falcon (ed.), *A New Thinking About* Res. *Roman Taxonomies in the Future of Goods (Palazzo del Bo – Padova, 21 luglio 2021*), Editoriale Scientifica, Napoli 2022, pp. 149 ff.

[2] See a complete overview in M.G. Marcoff, *Traité de Droit international public de l'espace*, Éditions universitaires Fribourg Suisse, Fribourg-Genève-Paris-New York 1973, pp. 143 ff.

could extend *usque ad sidera*[3], some scholars assumed that space and celestial bodies could constitute *res nullius*[4], referring directly to the Roman discipline of goods. According to this indeed very simple theory, outer space and celestial bodies would be assets without an owner, and therefore could be acquired through 'simple' occupation.

Yet, in order to prevent acquisition through occupation, and thus a fight for the survival of the fittest, States enshrined the principle of non-appropriation in the first two articles of the OST, a principle which is now recognised as *ius cogens*. According to the vast majority of the scholars, this choice implies the acceptance of the *res communes omnium* in the Treaty, although the Treaty itself does not explicitly mention them.

Overall, we could say that there is some kind of 'viscosity' of legal concepts that pushes scholars to hold on terms and expressions taken from our common legal history, especially in cases where a clear discipline is lacking.

[3] Cf. R. Quadri, *Droit international cosmique*, in *Recueil des cours*, XCVIII, 3, 1959, pp. 509, 531 ff.; Id., *Prolegomeni al diritto internazionale cosmico*, Istituto per gli studi di politica internazionale, Milano 1960, pp. 26 ff.; P. Gaeta - J.E. Viñuales - S. Zappalà, *Cassese's International Law*, Oxford University Press, Oxford 2020[3], pp. 92, 120. As E. Back Impallomeni, *Spazio cosmico e corpi celesti nell'ordinamento internazionale*, Cedam, Padova 1983, p. 22, note 1, points out, the medieval *brocarda* (*cuius est solum eius est usque ad coelom* and *dominus soli est dominus coeli et inferorum*) mount back to Ven. 2 *interd*. D. 43.24.22.4, but the interpretation of the source is highly controversial: see, about this topic, M. Falcon, Res communes omnium *e diritto dell'*outer space*. Contributo al dialogo sulla* Roman space law, in *TSDP*, XII, 2019, p. 32 (from now on: M. Falcon, Res communes omnium II, cit.), and Id., Res communes omnium. *Vicende storiche e interesse attuale di una categoria romana*, in L. Garofalo (ed.), *I beni di interesse pubblico nell'esperienza giuridica romana*, I, Jovene, Napoli 2016, p. 151 (from now on: M. Falcon, Res communes omnium I, cit.).

[4] Cf., on this theory, P. De Man, *Exclusive Use in an Inclusive Environment. The Meaning of the Non-Appropriation Principle for Space Resource Exploitation*, Springer, Cham 2016, pp. 21 f. and J. Tjandra, *The Fragmentation of Property Rights in the Law of Outer Space*, in *Air & Space Law*, XLVI, 3, 2021, p. 380. See, for recent theories that imply modifications of the OST, W. Erlank, *Rethinking* terra nullius *and Property Law in Space*, in *PELJ*, XVIII, 7, 2015, pp. 2503 ff. The category of *res nullius* bears some confusion in the discussion, since Roman jurists use this expression to indicate both things that do not belong to anyone but can be occupied by anyone, and things that do not belong to anyone because they cannot be acquired. Things falling into the latter category correspond to *res extra commercium* in Roman law, and are usually referred to, more precisely, as *res nullius in bonis*, as I pointed out in M. Falcon, Res communes omnium I, cit., p. 139. Not surprisingly, therefore, a minority of international law scholars also developed a thesis that considered outer space and celestial bodies as *res nullius* in the meaning of totally non-appropriable things: see on that M.G. Marcoff, *Traité*, cit., pp. 148 f.

2. *Some questions*

As the concept of *res communes omnium* is drawn clearly and overtly from Roman law, it is interesting to compare its meaning in ancient law to that enshrined in the OST. I will therefore try to outline first the main features of the non-appropriation principle, then those of *res communes omnium* regime in Roman law.

The non-appropriation principle essentially consists in the prohibition of «national appropriation», that could be carried out «by claim of sovereignty, by means of use or occupation, or by any other means».

It seems to be undisputed that the only entities which can carry out a «claim of sovereignty» are States[5], but they can also perform «use» and «occupation», as the OST says, just like private entities. In all cases, these behaviours are not adequate to achieve appropriation on or in open space.

Nowadays it is also possible that non-statal, private entities – like Blue Origin and SpaceX – reach and use or occupy some portions of, *e.g.*, the Moon, but international law scholars appear to agree that this kind of appropriation is either prohibited as well, because private use or occupation would anyway fall under the provision of art. II OST[6], or anyhow unconceivable because, where there is no statal legal system to recognise it, there cannot be any form of private property[7].

As many scholars recently pointed out, this whole regime could be unsatisfying for our present and future needs, for example because of the abundance on the Moon («a giant deposit of minerals»[8], as recently stressed by Andrea Capurso) and in many celestial bodies of minerals that are rare on Earth, and yet fundamental to many significant purposes, like the production of chips, batteries, and technological devices in general.

---

[5] Cf. S. Hobe - B. Schmidt-Tedd - K.-U. Schrogl, *Cologne Commentary* on *Space Law, I. Outer Space Treaty*, Berliner Wissenschafts-Verlag, Berlin 2009, pp. 235 f.

[6] Depending on the declination of this thesis, art. II OST would either apply to private entities directly or by virtue of a state endorsement, which would turn the acquisition into a national appropriation, see V. Pop, *Appropriation in outer space: the relationship between land ownership and sovereignty on the celestial bodies*, in *Space Policy*, XVI, 2000, pp. 276 ff.

[7] See F. Lyall - P.B. Larsen, *Space Law. A Treatise*, Routledge, London-New York 2018[2], p. 171; T. Ballarino - S. Busti, *Diritto aeronautico e spaziale*, Giuffrè, Milano 1988, pp. 157 f.

[8] Cf. A. Capurso, *The End of* res communes omnium, in M. Falcon, M. Milani (eds.), *A New Role for Roman Taxonomies in the Future of Goods? Atti del convegno di Padova (19 maggio 2022)*, Jovene, Napoli 2022, p. 60.

This situation, in the long run, could most likely trigger international disputes that will have to be tackled by jurists up to the challenge, if States do not expressly modify the OST.

In this scenario, the notion of *res communes omnium* has perhaps not been exploited to its full potential, so that a closer look from the perspective of Roman law might still be useful[9].

3. Res communes omnium *in Roman law*

Marcian – a Roman jurist who lived between the 2nd and the 3rd century AD – tells us that, according to natural law, there are things common to all, others that belong to a community, some that belong to no one, but everyone can appropriate them, others that belong to individuals, who can acquire them according to various mechanisms[10].

The same jurist draws up the list of *res communes omnium*: the air, the flowing water, the sea and '*per hoc*' (hence), the beach[11].

[9] In this order of thought cf. M. Falcon, Res communes omnium I, cit., pp. 143 ff.; Id., Res communes omnium II, cit., pp. 1 ff.; A. Capurso, *The Non-Appropriation Principle: A Roman Interpretation*, in *IISL Proceedings 2018*, The Hague 2019, pp. 111 ff.; D. Dursi, Res communes omnium *e* outer space. *Qualche riflessione*, in *BIDR*, CXVI, 2022, pp. 146 ff.

[10] Cf. Marcian. 3 *inst*. D. 1.8.2 pr.: *Quaedam naturali iure communia sunt omnium, quaedam universitatis, quaedam nullius, pleraque singulorum, quae variis ex causis cuique adquiruntur*.

[11] Cf. Marcian. 3 *inst*. D. 1.8.2.1: *Et quidem naturali iure omnium communia sunt illa: aer, aqua profluens, et mare, et per hoc litora maris*. As for the single things enlisted, doubts arose as to the authenticity of the reference to the *litus maris* (G. Lombardi, Res publicae iuris gentium, in *Ricerche in tema di* ius gentium, Giuffrè, Milano 1946, pp. 90 ff.), to *aer* (cf. P. Lambrini, *Per un rinnovato studio della tradizione manoscritta del Digesto: il caso di* aer *nell'elencazione delle* res communes omnium, in *Κοινωνία*, XLIV, 1, 2020, p. 817) or to *aqua profluens* (see L. Capogrossi Colognesi, *Ricerche sulla struttura delle servitù d'acqua in diritto romano*, Giuffrè, Milano 1966, p. 68): those references have been reckoned either senseless (U. Robbe, *La differenza sostanziale fra* res nullius *e* res nullius in bonis *e la distinzione delle* res *pseudo-marcianea «che non ha né capo né coda»*, I, Giuffrè, Milano 1979, in particular pp. 103 ff.) or interpolated (S. Perozzi, *Istituzioni di diritto romano*, I, Athenaeum, Roma 1928^2, pp. 596 ff.). Modern scholars tend to consider the list to be authentic, plausible (A. Dell'oro, *Le* Res communes omnium *nell'elenco di Marciano e il problema del loro fondamento giuridico*, in I. Fargnoli, C. Luzzati, R. Dell'Oro (eds.), *La cattedra e la toga. Scritti romanistici di A. Dell'Oro*, Giuffrè, Milano 2015, pp. 175 ff. [already in *Studi Urbinati*, XXXI, 1962-1963, pp. 237 ff.]; M. Falcon, Res communes omnium I, cit., pp. 132 ff.; M. Fiorentini, *Spunti volanti in margine*

The single items enlisted demonstrate that a thing is *communis omnium* when, while not being appropriable as a whole, it can be used and appropriated *pro parte*; or, if one prefers, that a thing enlisted is *communis omnium* in its natural status and falls partially into the property of an individual when altered by human beings[12]. This way, one can freely appropriate flowing water, can fish and hunt in the sea and in the air, and can also, as we shall see now in our focus, use the seashore as base for the activities connected to the sea.

On this topic, Marcian states that the seacoast is *communis omnium* '*per hoc*', which means that the shores are meant to be functional to the sea and to its exploitation. The legal regime of the seashore is therefore totally 'sea-oriented', according to the following rules.

Since it is a *res communis omnium*, a Roman 'John Doe' cannot appropriate the whole *litus*, but can use it to put a *casa* – a fishing hut – functional to his fishing activity. Marcian and other jurists, dealing with this case, state that, in this situation, both the manufact and the land below are in the ownership of the constructor. However, if for some reason the building collapses (*e.g.* because of a storm), the surface on which it was built returns *communis omnium*, and if someone builds something in the exact same spot, the previous owner has no remedy to contrast him and build his hut up again exactly where it used to stand. The limit of this use of the *res communis omnium* is that one cannot hinder everyone else's equal prerogative on the seashore[13].

al problema dei beni comuni, in *BIDR*, CXI, 2017, pp. 89 ff.; D. Dursi, Res communes omnium. *Dalle necessità economiche alla disciplina giuridica*, Jovene, Napoli 2017, pp. 21 ff.), and also exhaustive (M. Falcon, Res communes omnium I, cit., pp. 136 ff.; D. Dursi, Res communes omnium. *Dalle necessità*, cit., pp. 9 ff.; Id., Aelius Marcianus. Institvtionvm libri I-V, L'Erma di Bretschneider, Roma 2019, p. 155, but see F. Arcaria, Res communes omnium, in *Κοινωνία*, XLI, 2017, p. 666 and note 120). Further analyses in M. Falcon, *Alcune considerazioni sulle* res communes omnium *a partire da un saggio recente*, in *LR*, X, 2021, pp. 678 ff.

[12] This differentiates *res communes omnium* from the 'commons': see M. Fiorentini, *Spunti*, cit., pp. 75 ff.; Id., Res communes omnium *e* commons. *Contro un equivoco*, in *BIDR*, CXIII, 2019, pp. 153 ff.; M. Falcon, *Alcune considerazioni*, cit., pp. 683 ff.

[13] The regime in the text is enshrined in many sources in the Digest. Cf., for buildings on the seashore: Gai. 2 *rer. cott*. D. 1.8.5.1: *In mare piscantibus liberum est casam in litore ponere, in qua se recipiant*; Marcian. 3 *inst.* D. 1.8.6 pr.: *in tantum, ut et soli domini constituantur qui ibi aedificant, sed quamdiu aedificium manet: alioquin aedificio dilapso quasi iure postliminii revertitur locus in pristinam causam, et si alius in eodem loco aedificaverit, eius fiet*; Scaev. 5 *resp*. D. 43.8.4: *Respondit in litore iure gentium aedificare licere, nisi usus publicus impediretur*; for buildings in the sea: Cels. 39 *dig*. D. 43.8.3.1: *Maris communem usum omnibus hominibus, ut aeris, iactasque in id pilas eius esse qui*

In addition, Roman jurists state that passing of time cannot give foundation to stable property rights (Papinianus in D. 41.3.45 pr.[14]) and that, on the contrary, what is offered by nature on the seashore (like precious stones and gems) can be freely appropriated (Florentinus in D. 1.8.3[15]).

It is worth mentioning that Roman jurists are often very cautious in defining the ownership of the part of the beach below the construction: if Marcian himself, and before him Neratius, talk openly of *dominus* referring to the owner of the building[16], other jurists use more nuanced expressions (*eius esse*, for example) pertaining to the legal order proper to all mankind,

---

iecerit: sed id concedendum non esse, si deterior litoris marisve usus eo modo futurus sit; both cases are taken into account by Pomp. 6 *ex Plaut*. D. 41.1.50: *Quamvis quod in litore publico vel in mari exstruxerimus, nostrum fiat, tamen decretum praetoris adhibendum est, ut id facere liceat: immo etiam manu prohibendus est, si cum incommodo ceterorum id faciat: nam civilem eum actionem de faciendo nullam habere non dubito*.

[14] Pap. 10 *resp*. D. 41.3.45 pr.: *Praescriptio longae possessionis ad optinenda loca iuris gentium publica concedi non solet. Quod ita procedit, si quis, aedificio funditus diruto quod in litore posuerat (forte quod aut deposuerat aut dereliquerat aedificium), alterius postea eodem loco extructo, occupantis datam exceptionem opponat, vel si quis, quod in fluminis publici deverticulo solus pluribus annis piscatus sit, alterum eodem iure prohibeat*. On the passage see D. Nörr, *Die Entstehung der* longi temporis praescriptio. *Studien zum Einfluß der Zeit im Recht und zur Rechtspolitik in der Kaiserzeit*, Springer, Köln-Opladen 1969, pp. 97 f.; M. Kaser, Ius gentium, Böhlau, Köln-Weimar-Wien 1993, pp. 113 ff.; H. Ankum, Litora maris *et* longi temporis praescriptio, in *Index*, XXVI, 1998, pp. 370 ff.; L. D'amati, Aedificatio in litore, in *I beni*, cit., p. 658; R. Lambertini, *Limiti alla libera fruizione del mare, dei lidi e dei fiumi pubblici?*, in P. Garbarino, P. Giunti, G. Vanotti (eds.), *Confini, circolazione, identità ed ecumenismo nel mondo antico. Atti del VII Incontro di Studi tra storici e giuristi dell'antichità (Vercelli, 24-25 maggio 2018)*, Mondadori, Milano 2020, p. 85. A. D'Ors, *Un caso del llamado «*ivs praeoccupationis*» (Pap. 3 resp. – D. 41, 3, 45 pr.)*, in *AHDE*, LI, pp. 651 ff., thinks that the text originally dealt with *usucapio* and was later interpolated. Among international law scholars, see V. Pop, *Who Owns the Moon? Extraterrestrial Aspects of Land and Mineral Resources Ownership*, Springer, Berlin 2009, p. 82.

[15] Flor. *inst.* 6. D. 1.8.3: *item lapilli, gemmae ceteraque, quae in litore invenimus, iure naturali nostra statim fiunt*.

[16] Cf. Marcian. 3 *inst*. D. 1.8.6 pr.: *in tantum, ut et soli domini constituantur qui ibi aedificant, sed quamdiu aedificium manet: alioquin aedificio dilapso quasi iure postliminii revertitur locus in pristinam causam, et si alius in eodem loco aedificaverit, eius fiet* and Ner. 5 *membr*. D. 41.1.14 pr.: *Quod in litore quis aedificaverit, eius erit: nam litora publica non ita sunt, ut ea, quae in patrimonio sunt populi, sed ut ea, quae primum a natura prodita sunt et in nullius adhuc dominium pervenerunt: nec dissimilis condicio eorum est atque piscium et ferarum, quae simul atque adprehensae sunt, sine dubio eius, in cuius potestatem pervenerunt, dominii fiunt*.

i.e. ius gentium[17]. Perhaps this could be due to the awareness that *res communes omnium* could be used and appropriated not only by Roman citizens, but by foreigners too, also far distant from Rome.

We are now in the condition to build the parallel we were aiming for. Outer space, like the sea, is navigable and crossable; celestial bodies can be considered as 'bases' for human activities, for example to launch spacecrafts (in the movie '*Ad Astra*' you can see this very well: the main character travels from the Earth to the Moon and then from the Moon to Mars).

Can we use the relationship between sea and beach as a model to read the definition of open space and celestial bodies as *res communes omnium* in the OST[18]?

The treaty offers some hints in this direction, easily recognisable in some parts of art. I-IV OST:

1. Art. I, paragraph 2*: Outer space, including the Moon and other celestial bodies, shall be free for exploration and use* […] *and there shall be free access to all areas of celestial bodies*;
2. Art. II: *Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means*;
3. Art. III: *States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the Moon and other celestial bodies*;
4. Art. IV, paragraph 2: *The use of any equipment or facility necessary for peaceful exploration of the Moon and other celestial bodies shall also not be prohibited*.

In these articles, we find the principles we are already familiar with: freedom of use and exploration (artt. I, III and IV); incapacity of ownership (art. II); possibility to build facilities (art. IV); the principle of free access to all areas and the consequent limitation to exclusivity (art. I).

Plus, the prohibition of use and occupation as possible ways of acquiring property (art. II) shows that, just like in Roman law, possession and passing of time do not give rise to stable rights on celestial bodies[19].

---

17 On this matter see, for all, G. Lombardi, *Ricerche in tema di* ius gentium, Giuffrè, Milano 1946.

18 Cf. V. Pop, *Who Owns the Moon?*, cit., p. 83; M. Falcon, Res communes omnium II, cit., pp. 49 ff.

19 Use in article II is linked to «use or occupation» in article I (see S. Hobe - B. Schmidt-Tedd - K.-U. Schrogl, *Cologne Commentary*, I, cit., p. 243). As Eid., *Cologne Commentary*, I, cit., p. 244, state, the article means that «no amount of the use of outer space will ever suffice to justify, from a legal viewpoint, a claim of ownership rights over

The similarity between this regime and the Roman one is evident, including the fact that in both legal orders the relationship between the possibility to build facilities and the incapacity of appropriation is obviously a problem to solve.

Roman jurists tend to recognise a more or less full form of ownership over the part of *res communis omnium* that is appropriated, which seems to be in frontal opposition to the non-appropriation principle of the OST.

However, beyond the lexical difference between the use allowed by the OST on celestial bodies and the ownership recognised by some Roman jurists on the seashore, the regime is in the end quite similar, also because it is not easy to distinguish between full property rights and possession rights. In both Roman and international law, in fact, the constructor of the facility can use the area until the building remains upright, just like «a game of 'musical chairs'»[20] in which when someone eventually leaves his chair, someone else can freely occupy it.

In this scenario, it could also be theorised that the non-appropriation principle, which is rather unanimously read as qualifying outer space as a *res communis omnium*, prevents a total appropriation of a celestial body – an interpretation that fits quite well with the notion of national appropriation –, while allowing a partial appropriation through possession, which cannot give rise to stable rights.

the whole, or any part of outer space, including the moon and other celestial bodies». In conclusion, «these modes of acquisition, as well as the concept of 'continuous and peaceful effective control' giving rise to ownership rights, are not applicable to, or compatible with the *res communis* nature of outer space», and, as a consequence, «what the Outer Space Treaty prohibits is an 'appropriation by use' but not the 'use' of outer space, which is guaranteed», and «thus in practice, it may be more complex and difficult to draw a line between 'use' and 'appropriation by use', but such complexity must not nullify the legal principle of non-appropriation» (Eid., *Cologne Commentary*, I, cit., pp. 246, 257). These problems are the same that were already solved through Roman law in the 16th century, when the discussion dealt with the freedom of seas (see M. Fiorentini, *Mare libero e mare chiuso. Su alcuni presupposti romanistici dei rapporti internazionali nei secoli XVI-XVIII*, in Iuris vincula. *Studi in onore di M. Talamanca*, III, Jovene, Napoli 2001, pp. 326 f.).

[20] V. Pop, *Who Owns the Moon?*, cit., p. 82. As Pop pointed out, «while it is true that under the *res communis* regime no actor can usurp a prior user of a good and, in practice, possession can equate with property in this extent, this is not valid *ad infinitum*».

4. *Conclusive remarks*

These are of course only suggestions from the ancient notion of *res communes omnium*, that seems to become cyclically – at least since the *Mare liberum* by Hugo Grotius – a cornerstone of international law.

I do not think that the problems we face today, and those we will be facing tomorrow, can be solved by the reference to this ancient notion alone: but I believe that, before declaring the death of the *res communes omnium* principle in favour of a full private ownership regime in outer space, like some scholars suggest today, it could be worth trying to preserve the non-appropriation principle a little longer, perhaps taking advantage of the Roman experience, as seen above.

It is clear, however, that this mixed situation between communality and appropriation is apt to give rise to doubts and litigations, that States can try to avoid in advance by modifying the OST; alternatively, States can address those contrasts after they emerge, creating case-by-case law – of course a better option from a Roman law scholar point of view.

In the field of seashore and sea, Roman jurists identified remedies that could be used to resolve disputes arising between users of the *res communis omnium*. To do the same with outer space today, though, States would have first to identify a jurisdictional body to turn to, a move apparently not on their agenda at the moment.

Maria Gagliardi

The Law of Space Technology and Information: Risk Management and Liability Models

SUMMARY: 1. Introduction – 2. Space risks and opportunities – 3. Liability (liabilities?) for space activities – 4. Risks regulation and liability – 5. Concluding remarks.

1. *Introduction*

This paper does not move from a 'traditional' space law perspective; the arguments here contained try to show and to highlight how to manage some space-related risks as far as private entities are involved.

If we want innovation and incentives to national space economy, as our governors and statal entities seem to want, it is necessary that we ask ourselves what the law (at least domestic or national) can do in order to achieve innovation and to give incentives to private entities activities[1], while at the same time protecting collective and individual interests and rights[2].

In this sense, risk management and liability models can be used in the analysis of space technology and information in order to show how both prevention of risks and remedies for injuries and harms, once fixed at national and supranational level, can be characterized in space. In fact, for every type of risk, the management activities are divided in what can be done in order to prevent accidents and in what can be done after the accident, to remedy or to compensate losses.

[1] The scientific debate on the role of national space laws has different degrees of advancements in the vaious countries. Among the political and scientific communities with great awareness without doubt stand the United States of America. For instance, see J.S. GOEHRING, *U.S. Commercial Space Regulation: The Rule of Three*, in 13 *Journal of National Security Law & Policy* [2023] 337.

[2] Also the connection of risks with the domain of armed conflicts rises concern about liberties and rights of people, but this is outside the scope of this paper.

In the first direction, the prevention of risks is pursued through safety and security measures, mitigation solutions, etc. Generally the states regulate in detail specific duties and standards to comply with, depending above all on the potential (quantitative and qualitative: ie for the kind of infringed rights) gravity of the consequences. In the second perspective, remedies for losses are based primarily on compensation for damages. Here the states have a great variety of rules in order to establish which actor should bear the economic burden of damages: it can be the state itself, paying social benefits or indemnities; it can be the subject or entity conducting the activity on a 'strict' liability basis; it can be the subject or entity conducting the activity only on a 'fault-based' liability, thus in cases in which it should result non compliant with specific duties or with the general duty of care.

It is clear that different rules create different levels of incentives on the actors involved. In this sense it is said that civil liability rules have at least two typical functions[3]: compensation and deterrence. In some cases, civil liability performs also a punitive function, when the liable subject is selected on the basis of an evaluation which takes into consideration (also) the gravity of her behavior or conduct, and in cases in which the amount of damages is not related only to the loss suffered by damaged persons. In this perspective, both the choice of the rule of liability, and the rules governing the assessment and awarding of damages are extremely important as drivers of private activities and of diligence and precautions in conducting private activities.

The aim of this paper is to introduce the consideration of the mentioned risk management tools and functions in the analytical framework for governing space risks. In the relationship between the law of treaties and the national space laws, lays the possibility to identify spaces of relevance for (different models of) civil liability for damages caused on Earth or in outer space by scientific or commercial activities and services, being they conducted either by the states or by private entities.

The fact that the relevant international treaties have established a rule of (international and) financial responsibility for (launching) states is not considered a driver at all at national domestic level, if the several states are enacting national space laws, in which trying to say something more than the treaties about how the public authorities can regulate and govern space

[3] For an introduction to civil liability and to the possible combination with other solutions in pursuing the different functions, see: G. Ponzanelli, *La responsabilità civile*, Il Mulino, Bologna 1992; G. Comandé, *Risarcimento del danno alla persona e alternative istituzionali*, Giappichelli, Torino 1999.

national activities.

Therefore, the proposed perspective highlights a series of open questions to investigate about. For instance, it is not clear whether the responsibility of the launching state can be considered a good choice for every kind of damages, or if it is able to pursue both compensation for damages and incentives for sustainable private behaviors. We suggest that the research in this field would be conducted through a risk based analysis, trying to put at the center of the reasoning the existing need to use a comprehensive risk management approach also to the new activities and challenges in the developing space economy[4].

2. *Space risks and opportunities*

Space activities can be understood as the present and the future of our human and terrestrial culture. In this sense space activities can be conducted and used in different ways, only some of which can contribute to preserve and save human and terrestrial life and ecosystem. For instance, Earth observation technologies are constantly helping humankind to address many pressing challenges, as environmental protection. At the same time, all the several applications of the space economy – scientific and not – produce enormous number of debris, which create concerns and risks for possible impact with the Earth or with other celestial bodies or objects, as well as artificial objects and machines. The various applications of activities in space environment can serve very different objectives and goals, sometimes of public and collective utility, some others of private or lucrative interest. From another point of view, and also in consideration of these very different types of goals, space activities produce risks for goods, services and people's interests. Therefore, the complex legal and regulatory landscape surrounding these technologies and applications should aim at fixing rights and managing risks at the same time.

Many examples can be offered for explaining why it is necessary for space activities to be investigated under a civil liability and risk management perspective. In data processing, or in considering autonomy in space (Artificial Intelligence applications for instance) it is possible to

[4] The most recent developements in the activities included in space economy have pushed commentators to introduce the different concept of 'new space economy'. See S. Di Pippo, *Space Economy. La nuova frontiera dello sviluppo*, Bocconi University Press – EGEA, Milano 2022, pp. 71-72.

understand that it is not easy in space to define damages, both for the issue of causality, and for the problems related to assessment. Even considering the human oversight (an element at the center of debate for automation systems and applications), time delay factor can impact upon substantive law matters. Furthermore, in cases in which human oversight or human control are required as a rule or as a security measure, it is important to consider not only the problems related to the time necessary for human response, but also that in some cases the range of signals from and for Earth is limited. Therefore it is necessary to consider each risk as at the same time an ordinary risk and as a space risk[5], with possible different effects also in the ability to find existing applicable laws and legislation.

Furthermore, it should be considered the presence of new players in the field, rising the issue of a public/private divide in the performance of space activities and also the issue of possible complications in the attribution of the activities as for responsibility matters, for instance. This could probably mean and imply new categories, new actors, new interactions. If also new legal solutions are required is not yet completely clear, but in the meanwhile we have to use the available tools. New legislation is an issue and we have to eventually reach it, but we have also to re-interpret and read existing special laws and regulations in light of spatial applications. In fact, balances, fairness in attributing duties, and obligations could be affected by space environment considerations.

3. *Liability (liabilities?) for space activities*

Under article VI of the 'Outer Space Treaty' (OST) of 1967[6], states are assumed to bear *international responsibility* for *national activities* in outer space, even when those activities are carried out by non-governmental entities, like commercial companies[7]. Thus, the actions of non-state entities

[5] For a comprehensive application of similar considerations to armed conflicts implications, see E. Massingham and D. Stephens, *Autonomous Systems, Private Actors, Outer Space and War: Lessons for addressing Accountability Concerns in Uncertain Legal Environments*, in 23 *Melbourne Journal of International Law* [2022], 1-30.

[6] *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, opened for signature 27 January 1967 and entered into force 10 October 1967.

[7] «States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are

are linked to a state in order to define national activities.

For assessing duties and liabilities for 'national activities' it should be considered a broader system, resulting from other additional space treaties[8]. In short, it is said that states must grant authorization for activities of such non-governmental entities in outer space and that the liability that follows is absolute[9]. Nevertheless, no treaty fixes international standards or constraints (nor which legal system's rules should be applied) for granting authorization to private entities, and the state deemed responsible is the 'launching state'. Here there is typically space for 'launching forum shopping', i.e. the operator can try to choose the more convenient launching state under which to register and from which to be authorized. Under art. VIII OST, the state of registration of an object has the capacity to exercise jurisdiction (not clear), but nevertheless the object has not any nationality. Under art. VII OST and the Liability Convention, the launching state, and not the state of registration, is liable. Moreover, for the Liability Convention, at least four states can be considered launching states for the scope of liability: the state that launches, the state that procures the launch, the state that allows its territory or its facility to be used for a launch. It should be also added that a different (and further) state can also be the legal owner of the object. All that even if the Registration Convention requires that only one of the launching states be the state of registration. Therefore, even when the liability and financial warranty of the launching state is theoretically clear and absolute, in practice it could be more difficult to assess liabilities for space objects and activities, broadly speaking.

carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty» (art. VI OST).

[8] At least: the *Convention on the International Liability for Damage Caused by Space Objects*, opened for signature 29 March 1972 and entered into force 1 September 1971 (the 'Liability Convention'); and the *Convention on Registration of Objects Launched into Outer Space*, opened for signature 12 November 1974 and entered into force 15 September 1976 (the 'Registration Convention'):

[9] In more detail, the responsibility is absolute for damages to the Earth's surface or to aircrafts, while it is fault-based for damages caused by spatial objects to other spatial objects. On the international rules governing the assessment of the two kinds of liability, see for instance M.T.J. Sena, *Providing Clarity for Fault-based Liability in International Space Law: a Practical Approach through Principles of General International Law*, in 46 *Journal of Space Law* 1 [2022], 1 ff..

From a different perspective, the launching state is not necessarily the state which is involved with the main goal of the activity itself. Sometimes it could be that it has a specific interest or a public/private partnership, but other times the goal or return of the state could be much less clear. Furthermore, some national space laws seem to have suggested or introduced a compulsory insurance for private entities interested in conducting activities in outer space. It is not entirely clear whether those entities could be held liable under at least national laws, and which is the relationship between the two kinds of responsibility.

The international liability of the launching state is posed by the treaties as a warranty for not fully identified kinds of interests. Among these: humankind, community of states, individual rights. But it is not clear whether or not all the national activities conducted in space could be considered on the same level (of the same importance). In this light, the state's liability is a *financial* warranty in many cases, whether or not it is possible to find other liable actors. But it is also a *political* warranty, which serves as a way to make the several states accountable to each other and in this way to all.

For the same interests and kind of activities, under the several national laws there are specific basis for liability and there are established models of liability. A *prima facie* comparison with these models leads to identify on the launching state a sort of strict liability. But rules and limits for authorization, licensing requirements, standards and control are to be coordinated with existing general regulatory frameworks. One problem is that treaties are at a so high and general level that cannot fix any standards for the acceptability of the several missions, launches and so on. The launching states, assuming international liability for all the activities, have the right and duty (their primary obligation) to both authorize and supervise the operators, machines, devices etc.; than they have the duty to bear liability. But there is no homogeneity among the several national practices about requirements and standards to be met in order to gain authorization or license[10]. Nor there is common ground to decide on which sectors and areas of activities to put special regulation.

It seems that the same perspective is used by the initiative at level of European law, which is above all a sign of awareness at supranational level of the opportunity to look deeper into the ways to conduct space activities, also thinking of the possible consequences. The European Commission has

[10] On these issues, see J.S. Goehring, *U.S. Commercial Space Regulation: The Rule of Three*, cit., pp. 343 ff. mainly.

planned to propose an "EU space law" in 2024, with common rules on safety, security, and sustainability in space, above all because «in the absence of an EU regulatory framework, Member States are currently developing their national laws on space, with the risk of fragmentation which could negatively affect the competitiveness of EU industry, the security of the EU and its global influence in multilateral fora»[11].

4. *Risks regulation and liability*

The international liability of the launching state was a good solution in the Sixties, when all the activities in outer space were conducted and pursued by national states and to some extent by the international community. But many surrounding circumstances have changed in the meanwhile and private actors are significantly involved in space activities and in space economy. The goals pursued by the states and by the private entities are no more coincident or even overlapping: the issue of appropriation (and the ban to private property on spatial assets) is no more the most important one, when, for instance, space vectors gain huge amounts of money on the basis of millionaire contracts. It is the civilian and commercial market the primary source of technological innovation in space applications, and the states are becoming purchasers rather than developers of new technology. Therefore, the drivers for innovation and for security or safety should be adapted thinking to private actors and no more only to public entities. Private companies put satellites aiming to serve their own commercial scopes or other parties' interests, thus attributing great commercial value to the goods and services, intended above all as information.

Availability of services provided in outer space by private entities can produce international consequences but also constraints about at least transparency, fair use or misuse of information, security, and so on. Maybe it is time to recognize that not every liability model can be used to reach both (at least) financial warranty for political and diplomatic balances and at the same time good and reasonable incentives for private entities' activities and behaviors. In other words, the choices of the several states should be read in light of the at least two main perspectives embedded

[11] https://www.eesc.europa.eu/en/our-work/opinions-information-reports/opinions/eu-space-law#:~:text=The%20European%20Commission%20is%20therefore,security%2C%20and%20sustainability%20in%20space.

in space regulation: on the one hand we have the necessity to make states accountable for space activities, both at geopolitical level and as warranty for the entire community; on the other hand, the risks related to the activities of space economy are in any case linked to the choices of private entities and actors. Therefore the two dimensions are intertwined and should be governed as such.

Furthermore, any national space law – which has and wants to have a great importance in various choices - should be combined with the existing regulatory framework governing generally the activities now undertaken also in space.

A good example could be the use of data and the use of artificial intelligence in space: in these cases the challenges for the law are about how to apply or to adapt existing European and national regulations to specific goals (for instance Earth Observation), or to specific contexts (for instance to the notion of autonomy, to the way of granting human oversight, to the different physics of time).

Furthermore, there is a matter of relationship between general law and special law: in deciding which actor is liable and on what basis for liability, it is necessary to decide the issues thinking to the goals that the several liability models aim at in the space domain. But there are also concurring liability rules governing sectorial disciplines, as in the case of the use of Artificial Intelligence, of data protection, of cybersecurity, and so on.

To have fixed (international or civil) liability on the launching state could not be a great idea standing alone. In fact, the launching state could not be a good payer, i.e. a 'deep pocket', at least for the aggregate of for instance objects put in orbit. Which consequences if the state does not pay damages?

On the other side the states can have different reasons and interests in bearing responsibility for other actors' activities: taking responsibility means either using the activities or sustaining them. The private actors launching any type of object have private interests in that, and the launching state should verify and control security, safety, utility… and so on. Sometimes it is the state that needs private actors to pursue national own goals, but some other times the state simply accepts to "sponsor" a private actor in order to gain indirectly other advantages.

In all these cases, it is possible that – once paid damages on the state liability basis – the state can ask the private actor to recover the amount of damages, or part of it. It is even possible to imagine an incentive or a duty to insure for private actors willing to make business with space economy[12].

[12] Insurance requirements are included in both US (*Commercial Space Launch Activities*

It is above all in this sense that "traditional" civil liability rules should be considered in the contest of space economy. And it is in this contest that a pivotal role can be played by the national space legislations. When we look at the management of activities and related risks by private actors, there are many open questions in thinking of possible solutions for their liability. Moreover, it should be noted that some elements conditioning the attribution of a liability, such as both the assessment of fault and the assessment of damages (losses), could be not so easy, due to the peculiarities of the space dimension of the accidents. Therefore, on a civil law basis, national space legislation has to take into consideration many issues.

5. *Concluding remarks*

Existing international treaties deal with liability for accidents only charging the launching state with any consequence for public and private activities causing damages. It is a liability model which is neither based on property, nor on production, nor on exploitation. It is a sort of strict (international) liability of the state. There is no explicit connection with a civil liability on other actors, there is no description of elements affecting the duties, the standards, the fairness of behaviors and activities. There is no provision about possible rights or actions of private citizens against the responsible states or against their own state who has relationship with the other (liable) states.

We have to analyze carefully advantages and disadvantages of different possible solutions, and maybe it could be a good idea to start from a risk-based analysis. Moving from applications of space economy activities it could be possible to identify both specific risks to take into consideration, and specific problems in the application of general law to the space context. Thus it would be easier to try to imagine solutions suitable at the same time for managing risks specific for space, while pursuing the goals fixed by regulators.

It is because of all these gaps that it is necessary to look at national laws and regulations for a coherent consideration of possible functions of civil liability.

Act 1994) and Australian (*Space (Launches and Returns) Act* 2018) national space laws, for instance. It seems the choice also of the Italian Govermnent, included in the recent proposal of the first Italian national space law.

Diego Mauri

Hybrid Warfare in Outer Space: Where Does International Law Stand Today?[*]

Summary: 1. Setting the Stage: Outer Space as a Domain of (Hybrid) Warfare – 2. What Is in a Name: Hybrid Warfare and Related Concepts – 3. Outer Space: From 'Black' to 'Grey' – 4. International Law Applicable to 'Hybrid' Space Activities – 5. Paths to Take, Paths to Avoid.

1. *Setting the Stage: Outer Space as Domain of (Hybrid) Warfare*

In the aftermath of the Russian Federation's test of an anti-satellite weapon (ASAT) against its own *Cosmos-1408*, which took place on November 15, 2021, the reaction of several States – the US and EU Member States in the first place – was a heartfelt condemnation: as that ASAT test targeted a Soviet-era satellite placed on a Low Earth Orbit (LEO), fragments and *debris* generated by the kinetic impact will reasonably take years before descending in the atmosphere, thus endangering space activities for a significant lapse of time. The Russian conduct was labelled as «irresponsible behaviour in outer space»[1]. Less than a year later, the Russian representative at the UN General Assembly denounced an «extremely dangerous trend» taking place in the skies above Ukraine (against which the Russian Federation had been involved in an armed conflict since February 2022), namely the utilization of the Starlink system – owned and operated by a US-based company, SpaceX – by the Ukrainian armed forces[2].

[*] This research has been supported by the "Project Hybrid Threats versus Democratic Resilience: An Analytical and Practical Toolkit (HYDRA)", funded by the European Union within the "PRIN 2022 PNRR" program of the Italian Ministry of University and Research, CUP B53D23032490001.

[1] *Statement by the High Representative of the Union for Foreign Affairs and Security Policy on behalf of the EU on the Russian Anti-Satellite Test on 15 November 2021*, 19 November 2021.

[2] *Statement by Deputy Head of the Russian Delegation Mr. Konstantin Vorontsov at the*

Those are but instances of the importance of outer space for military activities carried out by States, inside as well as outside armed confrontation. Basing on those (and other) instances, many commentators have begun to conceive outer space as a «warfighting domain» or a «military domain», more precisely the *fourth* one (the first being 'land', the second 'sea', the third 'air', and the fifth 'cyber')[3]. It is not difficult to grasp why: the outer space is teeming with military-sensitive technologies, such as satellites and systems for communications, transportation, navigation, global positioning, ISR (i.e. intelligence, surveillance, reconnaissance), early warning. Their role in contemporary societies' lives could hardly be overestimated.

More recently, the point has been made that, in addition to direct military confrontation, other state activities aiming at destabilizing opponents could be conducted in this domain: put differently, outer space too could become the theatre of «hybrid warfare». This concept – which literally exploded in recent years – has been crafted by several States and military alliances (mostly Western)[4]. According to NATO, hybrid «threats» are «[c]oordinated and synchronized actions that deliberately target the systemic vulnerabilities of democratic states or institutions in order to reach strategic goals and create the desire effects»[5]. Conducts pertaining to the conceptual area of hybrid warfare are placed in a sort of 'grey area' between war and peace, which challenges rules and principles of international law as they currently exist.

The present paper aims to explore the connections between the concept of hybrid warfare and outer space from an international law perspective. To this end, it will delve into the concept of hybrid warfare, exposing difficulties associated with identifying a working definition thereof due to its essentially political – and thus contested – nature (section 2). The paper will then apply this concept to state and non-state activities that have been

Thematic Discussion on Outer Space (Disarmament Aspects) in the First Committee of the 77th Session of the UNGA, 22 October 2022.

[3] See more extensively S. McCosker, *Domains of Warfare*, in B. Saul, D. Akande (eds), *The Oxford Guide to International Humanitarian Law*, Oxford, 2020, p. 77, in particular p. 86.

[4] For a primer on hybrid warfare, see the seminal work of A. Sari, *Legal resilience in an era of grey zone conflicts and hybrid threats*, in *Cambridge Review of International Affairs*, 2020, p. 846; C. Marsch, *The Grey Zone and Hybrid Conflict. A Conceptual Introduction*, in M. Regan, A. Sari, *Hybrid Threats and Grey Zone Conflict*, Oxford, 2024, p. 31.

[5] M. Höyhtyä, S. Uusipaavalniemi, *The space domain and the Russo-Ukrainian war: Actors, tools, and impact*, Hybrid CoE Working Paper 21, September 2023, available at <https://www.hybridcoe.fi/wp-content/uploads/2023/01/20230109-Hybrid-CoE-Working-Paper-21-Space-and-the-Ukraine-war-WEB.pdf>.

regularly carried out (or that will reasonably be in the near future) in outer space (section 3). The following section (4) will be dedicated to testing the adequacy of existing norms of international law as applicable to outer space activities to cope with the reality of hybrid warfare. Lastly and by way of conclusion, some trends emerging from recent practice will be pointed out (section 5).

2. *What Is in a Name: 'Hybrid Warfare' and Related Concepts*

The concept of hybrid 'warfare' – sometimes referred to also as hybrid 'attacks' or 'threats', depending on source and context – has been experiencing a period of incredible success. If the definition proposed above is accepted[6], one could easily rebut that the concept itself is as old as humanity: in the célèbre *The Art of War*, Sun Tzu affirmed that «[t]he supreme art of war is to subdue the enemy without fighting»[7]. While this sentence (dating back the sixth century BC) cleverly captures the inherent feature of the concept of hybrid warfare – that is, targeting the enemy through means that fall short of war in its proper sense –, it must be noted at the outset that technological advances have made possible forms and degrees of intrusiveness and confrontation that was simply unimaginable few decades ago (let alone millennia ago!). Considering this, one cannot but notice the structural difference between the conducts that are relevant for the contemporary concept and those relevant for the ancient one.

Turning to how hybrid warfare is understood today, it is helpful to rapidly sketch a biography of that concept. The institutional framework in which it was conceived and tested is the Organization of the North Atlantic Treaty (NATO). In the 2010 Strategic Concept, NATO Member States took into consideration the reality of cyberattacks, arguing that «[f] oreign militaries and intelligence services, organised criminals, terrorist and/or extremist groups can each be the source of such [cyber] attacks»[8]. In another document specifically dealing with hybrid warfare, the parallel notion of hybrid 'threats' was defined as «those posed by adversaries, with

[6] See *supra*, section 1.

[7] Sun Tzu, *The Art of War*, translated by J.J.L. Duyvendak, S. Yang, S. Yuan, Stansted, 1998, p. 37.

[8] Nato, *Active Engagement, Modern Defence. Strategic Concept for the Defence and Security of the Members of the North Atlantic Treaty Organization*, adopted 19-20 November 2010, para. 12.

the ability to simultaneously employ conventional and non-conventional means adaptively in pursuit of their objectives»[9].

While back then what Member States had mostly in mind were terrorist attacks by non-state actors (both on Western soil and abroad)[10], a new reality was making its way in the international arena, as in 2007 Estonia was famously targeted by a cyberattack causing a 'Distributed Denial of Service' (DDoS) and allegedly attributable to a Russia-backed hacktivist group[11]. In the following years, NATO and its Member States progressively applied the concept of hybrid warfare to conducts attributable to state actors, namely the Russian Federation and China.

In the aftermath of the Russian invasion of Crimea in February 2014, NATO States adopted a declaration not only condemning that act, but also stressing the importance of building a defensive strategy vis-à-vis «hybrid warfare threats [*sic*], where a wide range of overt and covert military, paramilitary, and civilian measures are employed in a highly integrated design»[12]. Such reference to hybrid warfare was far from fortuitous: as is known, the Russian Federation resorted to non-state groups (the so-called «Little Green Men») to infiltrate Crimea and join forces with irregular troops located there[13]. Simultaneously, another key security actor in the European continent, i.e. the European Union (EU), began to show interest in the topic: in 2015, both the EU Defense Ministers and the European External Action Service discussed hybrid warfare and called for shared actions at the supranational level[14]. NATO and the EU eventually joined

[9] The document is quoted in M. Aaronson et al., *NATO Countering the Hybrid Threat*, in *Prism*, 2011, p. 111, at p. 115.

[10] Back then, the US-led *Global War on Terror* was actively conducted. For a critical appraisal of such 'war' from the angle of international law, see M.E. O'Connell, *The Legal Case against the Global War on Terror*, in *Case Western Reserve Journal of International Law*, 2004, p. 349.

[11] See M. Roscini, *World Wide Warfare –* Jus ad bellum *and the Use of Cyber Force*, in A. von Bogdandy, R. Wolfrum (eds), *Max Planck Yearbook of United Nations Law*, 2010, p. 85.

[12] Nato, *Wales Summit Declaration. Issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in Wales*, 5 September 2014, para. 13.

[13] T.D. Wentzell, *Russia's Green Men: The Strategic Storytellers of Hybrid Warfare*, in *Canadian Military Journal*, 2021, p. 42.

[14] See EEAS, *Food-for-thought paper "Countering Hybrid Threats"*, 8887/15, 13 May 2015.For more on the European stance vis-à-vis hybrid warfare, see L. Lonardo, *The seriousness of vagueness: introducing European law and policies against hybrid threats*, in L. Lonardo (ed), *Addressing Hybrid Threats. European Law and Policies*, Cheltenham-Northampton, 2024, p. 1.

their efforts in 2017, setting up a Centre of Excellence for Countering Hybrid Threats (Hybrid CoE)[15].

Hybrid warfare has since then been regularly referred to in NATO and EU official documents dealing with security[16], up to the 2022 Strategic Concept[17]. Here, interestingly, the potential sources of hybrid threats are identified not only in Russia, but also in China[18]. Even if not quoted, reference here must be understood to China's interests in the South China Sea and the Taiwan Strait, a region where military escalation is believed to be plausible in the near future[19].

Having said this, one may inquire what is the actual *content* of the notion of hybrid warfare. As this has been understood as featuring conventional and non-conventional means, put in place either by state and non-state actors, covertly or overtly, to exploit democratic States' structural vulnerabilities and weaken them, one may rightfully conclude that virtually *anything* that is done *against* the interests of Western States and that exploits their vulnerabilities would be included in the concept. As a confirmation, some authors have described the concept as a «contested» one, working as a mere «catch-all phrase or buzzword»[20].

For the purposes of the present contribution, it seems more useful to leave aside definitional quandaries and to focus on *specific* domains (or instances) in which the concept of hybrid warfare is believed to articulate. These include – but are not limited to – cyberattacks against critical infrastructure, disinformation campaigns (e.g., on political elections)[21],

[15] See NATO, *Statement on the implementation of the Joint Declaration signed by the President of the European Council, the President of the European Commission, and the Secretary General of the North Atlantic Treaty Organization*, 6 December 2016. As of today, after the adhesion of Albania, the Hybrid CoE is composed of 36 Members, including all EU and NATO Member States.

[16] See NATO, *Brussels Summit Declaration. Issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in Brussels*, 11-12 July 2018, para. 13; Id., *Brussels Summit Communiqué. Issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in Brussels*,14 June 2021, para. 31. For the legal implications of those declarations, see *infra* section 4.

[17] NATO, *2022 Strategic Concept. Adopted by the Heads of State and Government at the NATO Summit in Madrid*, 29 June 2022.

[18] *Ibidem*, para. 13.

[19] See Marsch, *The Grey Zone and Hybrid Conflict. A Conceptual Introduction*, cit., p. 33.

[20] E. Reichborn-Kjennerud, P. Cullen, *What is Hybrid Warfare?*, in *Norwegian Institute of International Affairs Policy Brief*, 2016, p. 1.

[21] G.M. Ruotolo, *Nell'anno delle elezioni hanno tutti ragione. Alcune considerazioni sul ruolo del diritto internazionale ed UE nel contrasto alla disinformazione*, in *SIDIBlog*, 5

boosting migratory routes[22], and illegal, unreported and unregulated fishing (so-called IUU fishing) on the high seas adjacent to States' Exclusive Economic Zones (EEZ)[23]. As one may easily note, the variety of those areas requires that each one of them be addressed severally, that is, one the one hand, with regard to its inherent features, and, on the other hand, taking into account the legal framework that applies specifically.

In addition to this, it is worth noting that all definitions of hybrid warfare and related concepts embrace also the 'vulnerabilities' of the intended targets. This is due to the fact that States that are members of the relevant organizations (NATO and the EU) are democratic systems based on the rule of law and the respect of fundamental rights: hybrid warfare can prove particularly effective against those systems, as their margin of reactions is restrained by numerous norms (e.g., as laid down in domestic Constitutions and enshrined in human rights treaties). As a result, the discussion around the topic of hybrid warfare is centered in the notion of legal 'resilience', which describes the effort to put in place preventive and mitigatory measures against hybrid threats, without jeopardizing core democratic values[24].

Turning now to the topic that this paper addresses, it is worth noting that NATO States have expressly identified outer space as a domain where hybrid warfare can – and actually *is* – conducted. In the already mentioned 2022 Strategic Concept, it is acknowledged that «authoritarian actors challenge [NATO Member States'] interests, values and democratic way of life», and that those actors «conduct malicious activities in cyberspace and space»[25]. The recent practice of military confrontation in outer space – as

aprile 2024, available at <http://www.sidiblog.org/2024/04/05/nellanno-delle-elezioni-hanno-tutti-ragione-alcune-considerazioni-sul-ruolo-di-diritto-internazionale-ed-ue-nel-contrasto-alla-disinformazione/>. More generally on the topic of fake news from an international law viewpoint, see B. Baade, *Fake News and International Law*, in *European Journal of International Law*, 2019, p. 1357.

22 R. Parkes, *The EU's 'hybrid' migration wars: a case of mistaken identity*, in L. Lonardo (ed), *Addressing Hybrid Threats. European Law and Policies*, cit., p. 84. See also S. Caballero Sanz, *The concepts and laws applicable to hybrid threats, with a special focus on Europe*, in *Humanities and Social Sciences Communications*, 2023, p. 1.

23 V. Schatz, M. McCreath, *EEZ-adjacent distant-water fishing as a global security challenge: An international law perspective*, *Hybrid CoE Working Paper 19*, September 2022, available at <https://www.hybridcoe.fi/wp-content/uploads/2022/09/20220912_Hybrid_CoE_Working_Paper_19_DWF_WEB.pdf>.

24 On the notion of 'legal resilience', see A. Sari, *Legal Resilience: Just a Warm and Fuzzy Concept?*, in M. Regan, A. Sari, *Hybrid Threats and Grey Zone Conflict*, cit., p. 533.

25 NATO, *2022 Strategic Concept. Adopted by the Heads of State and Government at the*

the *Starlink* case aptly epitomizes – calls for a thorough reflection on the implications stemming from those affirmations[26].

3. *Outer Space: From 'Black' to 'Grey'*

Outer space *in itself* displays characteristics that appear well suited for a domain of hybrid warfare. It is possible to outline at least three features: (1) the presence of a variety of non-state actors; (2) the employment of military-sensitive technologies for activities to be conducted in that domain; (3) the usability of non-kinetic and covert means to disrupt or neutralize the enemy's assets.

As per the *first* feature, outer space is now populated by thousands of private operators (such as SpaceX): in the last decade, what was an area accessible only to a small group of actors (mainly States) has turned into «a vital sphere of commercial and military operations»[27]. In addition to owing about 2 out of 3 satellites orbiting around the Earth, private companies will soon engage in a plethora of space activities, such as travelling to other celestial bodies, space tourism, and even placing space stations[28]. This situation will not only fuel confrontation among States (the US, Russia and China, to name only the most active spacefaring countries), but also competition among those private companies. As a common expression goes, outer space is deemed to get even more «congested, contested, and competitive»[29] as it is nowadays. Actors operating in outer space are (and will be) driven by the desire to ensure their own freedom of action while striving to restrict others', which is the gist of the very notion of hybrid warfare[30].

The *second* feature that it is appropriate to focus on is the presence of military-sensitive technology, in particular dual-use objects such as

NATO Summit in Madrid, cit., para. 7.

[26] As a confirmation, the Hybrid CoE has dedicated an *ad hoc* publication to outer space: see Höyhtyä, Uusipaavalniemi, *The space domain and the Russo-Ukrainian war: Actors, tools, and impact*, cit.

[27] M. de Zwart, *Hybrid and Grey Zone Operations in Outer Space*, in M. Regan, A. Sari, *Hybrid Threats and Grey Zone Conflict*, cit., p. 289, at p. 293.

[28] See J. Foust, *Commercial space stations go international*, in *Space News*, 3 July 2024, available at <https://spacenews.com/commercial-space-stations-go-international/>.

[29] R. Harrison, *Unpacking the Three C's: Congested, Competitive and Contested Space*, in *The International Journal of Space Politics & Policy*, 2013, p. 123.

[30] See Sari, *Legal resilience in an era of grey zone conflicts and hybrid threats*, cit., p. 856.

satellites and navigation systems. As a matter of fact, contemporary space technology is described as «inherently dual use», serving both civilian and military purposes[31]. SpaceX' Starlink has clearly demonstrated its dual-use nature, being employed both by private persons longing for high-speed Internet connection around the globe and by state actors, such as the already mentioned Ukrainian army in the context of the ongoing armed conflict against the Russian Federation[32]. This makes space objects particularly desirable objectives of hostile activities: neutralizing them can cause substantive damage to civilian infrastructure and military assets.

The *third* feature is that the means through which such neutralization can be sought combine kinetic and non-kinetic force. The practice of ASAT tests, which major spacefaring States have conducted in the last decades (the US, China, India, and the Russian Federation), seems an anticipation of future active engagements of enemy satellites[33]. As far as the November 2021 Russia's test, it has been argued that Russia's ultimate objective was not the direct target that it engaged (its own satellite), but rather Starlink satellites, placed below the *Cosmos-1408*'s orbit: the test was allegedly intended to cause disturbances to the US-based company, few weeks before the full-scale invasion of Ukraine[34]. However, kinetic means are not the sole tools to be employed in the space dominion. In addition to direct-laser weapons, cyberweapons may turn a formidable instrument to target enemy systems and infrastructure *covertly* – something that traditional, kinetic-force tools could hardly ensure[35]. Not only is the malicious source of the attack harder to discover, but it is also simpler for the authors to deny their involvement in the operation (i.e. «plausible deniability»), as commonly happens with cyberoperations in terrestrial domains. A scenario recently

31 de Zwart, *Hybrid and Grey Zone Operations in Outer Space*, cit., p. 294.

32 For a discussion of Ukraine's use of Starlink technology and the anticipated reactions by Russia, see D. Mauri, *Cose dell'altro mondo: la Russia considera obiettivi militari alcune costellazioni commerciali di satelliti*, in *Quaderni di SIDIBlog*, 2022, p. 145.

33 On ASAT tests and future employments, see more extensively D. Koplow, *ASAT-isfaction: Customary International Law and the Regulation of Anti-Satellite Weapons*, in *Michigan Journal of International Law*, 2009, p. 1188.

34 As a matter of fact, a few months after the Russian test the debris generated by the destruction of the Soviet-era satellite approached SpaceX's constellation, risking causing extensive damage: see J. Foust, *Starlink satellites encounter Russian ASAT debris squalls*, in *Space News*, 9 August 2022, available at <https://spacenews.com/starlink-satellites-encounter-russian-asat-debris-squalls/>.

35 See J. Pavur, I. Martinovic, *The Cyber-ASAT: On the Impact of Cyber Weapons in Outer Space*, in T. Minárik et al. (eds), *2019 11th International Conference on Cyber Conflict: Silent Battle*, Tallinn, 2019, p. 1.

simulated in the NATO framework concerns the use of a cyberweapon not against on-orbit satellites, but against Space Situational Awareness (SSA) systems[36]. In the context of the Russo-Ukrainian conflict, the Russian Federation conducted a cyberattack against the Viasat satellite network – a ground-based infrastructure –, which resulted in major disruptions of Ukrainian modems and across European States[37]: incidentally, this demonstrates also the degree of interconnectedness between States, which makes it difficult to contain cyberattacks in a spatially determined area.

As the concept of hybrid warfare implies that of targets' 'vulnerability'[38], the space environment – including ground-based infrastructure, as mentioned above – is renown as being particularly vulnerable to hybrid threats. In current debates, as far as outer space is concerned, this notion is understood mainly in its *technical* sense: some fear that the increasing confrontation in the space domain, between state and non-state actors, will increase risks to human activities, thus pushing those actors to internalize higher costs and discouraging new ones to invest in the space field[39].

Put short, hostile 'competition' is likely to obfuscate genuine 'cooperation' in the use and exploration of outer space, a phenomenon that, metaphors aside, runs in contravention with the cornerstone principle of international space law, that is the pacific use of outer space, which must be explored and used «for the benefit and in the interests of all countries», as enshrined in the so-called Outer Space Treaty (OST)[40]. From this perspective, it is easy to see how the tactics of hybrid warfare are likely to impact on the respect and the application of existing rules and principles of international law, which is now appropriate to investigate.

[36] See D. Mauri, *Attività di impiego e di* testing *di armi anti-satellite e diritto internazionale*, in *Rivista di diritto della navigazione*, 2022, p. 635, at p. 639.

[37] Höyhtyä, Uusipaavalniemi, *The space domain and the Russo-Ukrainian war: Actors, tools, and impact,* cit., p. 10.

[38] See *supra*, para. 2.

[39] de Zwart, *Hybrid and Grey Zone Operations in Outer Space*, cit., p. 296.

[40] *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, adopted on 19 December 1966, Preamble and art. I.

4. *International Law Applicable to 'Hybrid' Space Activities*

4.1 *Overview*

As of today, no one doubts that international law applies fully to activities conducted in the space domain[41]. In addition to international space law (which flourished in the 1960s and in the 1970s), other branches of international law regulate what state and non-state actors do in outer space.

The first branch that may come to the fore is international humanitarian law (IHL), that is the law applicable to armed conflicts, both of an international and of an internal nature. IHL regulates what States and other armed groups can do in the battlefield: it is traditionally referred to as *jus in bello*. It is today held that IHL is not limited to armed confrontation on Earth but applies also to military operations in outer space: international legal scholarship anticipating what may come in case of 'space wars' have blossomed in recent years[42]. The future use of ASAT in actual combat scenarios – and not as simple tests – elicited a vivid debate in the international community[43].

The other body of norms that would regulate activities in outer space – and which is even more of interest when discussing hybrid warfare – is the law on the use of force, or *jus ad bellum*, which establishes the conditions meeting which States are allowed to use force in international relations. The bedrock rules of this entire body of law are to be traced in the UN Charter. Article 2(4) establishes as one of the «principles» of the UN the prohibition of the threat and use of force against the territorial integrity or political independence of any State, or in any other manner incompatible with the Charter[44]. This rule is universally acknowledged as customary in

[41] B. Cheng, *The Military Use of Outer Space and International Law*, in B. Cheng (ed), *Studies in International Space Law*, Oxford, 1997, p. 523; C. Cepelka, J.H.C. Gilmour, *The Application of General International Law in Outer Space*, in *Journal of Air Law and Commerce*, 1970, p. 30.

[42] See D. Stephens, C. Steer, *Conflicts in Space: International Humanitarian Law and its Application to Space Warfare*, in *Annals of Air & Space Law*, 2015, p. 2; M. PEDRAZZI, *Il diritto internazionale dello spazio e le sue prospettive*, in *Quaderni di relazioni internazionali*, 2008, p. 46; S. Marchisio, *Gli usi militari dello spazio: scenari internazionali e tavoli negoziali*, in S. Marchisio, U. Montuoro (eds), *Lo spazio* cyber *e cosmico. Risorse* dual use *per il sistema Italia in Europa*, Torino, 2019, p. 145.

[43] For an overview, see Mauri, *Attività di impiego e di* testing *di armi anti-satellite e diritto internazionale*, cit., at p. 646.

[44] *Charter of the United Nations Organization*, adopted on 26 June 1945.

nature[45], and by some also corresponding as an imperative norm of the international legal system (to the point that this branch of law is sometimes referred to as *jus contra bellum*)[46].

Taking into account this second set of international rules and principles, and other norms of general international law, it seems appropriate to identify specific norms and to apply them to activities that may take place in outer space and that may qualify as instances of hybrid warfare.

4.2 *Violations of Sovereignty and The Principle of Non-Intervention*

One of the core rules of the Westphalian international community is that as States possess equal rights and duties, they are obliged to respect other States' sovereignty, that is to refrain from interfering in their internal and external affairs. This principle is so pivotal in the modern and contemporary international legal system, that its actual meaning and content changes constantly, depending on the historical and political context in which it operates[47]. The duty to respect other States' sovereignty has generated another crucial rule as 'corollary', namely the prohibition of intervention in the domestic sphere of other States[48]. The relationship between those two norms – as well as their constitutive elements – is heavily contested and debated in academia.

As regards the principle of non-intervention, States are prohibited from intervening in the so-called «domaine réservé» of other States, that is those matters in which States are free to decide their actions[49],

[45] International Court of Justice (ICJ), *Military and Paramilitary Activities in and against Nicaragua (Nicaragua v. United States of America)*, Judgment of 27 June 1986, para. 188.

[46] M. E. O'Connell, *The Prohibition on the Use of Force*, in N. White, C. Henderson (eds), *Research Handbook on International Conflict & Security Law,* Cheltenham-Northampton, 2013, p. 89; O. Corten, *The Law Against War*, Oxford, 2010, p. 55; R. Kolb, *Ius contra bellum. Le droit international relatif au maintien de la paix: précis*, Bruxelles, 2009, p. 247.

[47] S. Besson, *Sovereignty*, in R. Wolfrum (ed), *Max Planck Encyclopedia of Public International Law*, April 2011, para. 3.

[48] See M. Jamnejad, M. Wood, *The Principle of Non-Intervention*, in *Leiden Journal of International Law*, 2009, p. 345; R. Sapienza, *Il principio del non intervento negli affari interni. Contributo allo studio della tutela giuridica internazionale della potestà di governo*, Milano, 1990, and more recently M. Roscini, *International Law and the Principle of Non-Intervention. History, Theory, and Interactions with Other Principles*, Oxford, 2024.

[49] ICJ, *Military and Paramilitary Activities in and against Nicaragua (Nicaragua v. United States of America)*, cit., para. 205.

without constraints from the international legal system (to name one, the formulation of foreign policy)[50]. In order to qualify as such, forms of intervention must be coercive in nature, that is they must involve the use of «economic, political or any other type of measures […] in order to obtain [from the coerced State] the subordination of the exercise of it sovereign rights and to secure from it advantages of any kind»[51]. It is held that, while coercion may take a multitude of forms, it must in all cases result in the targeted State's impossibility to reasonably resist the pressure[52]. Such a traditionally high bar would render mere 'interference' – that is, intervention short of the element of coercion – in line with the principle, and absent any other primary rule prohibiting or regulating it, lawful under existing international law[53].

The rapidly evolving technology in the cyberspace has challenged the content and the limits of these ancient rules of international law. Many functions that States exercise in the cyber domain – such as the delivery of social services, the conduct of elections, the collection of taxes, and national defense – are at risk of being interfered with through covert operations that may not amount to 'intervention' as defined above: one of the clearest examples in this regard is cyber espionage[54]. This is why recent state practice has pushed itself to admit that in some cases violations of sovereignty through cyber means, which do not amount as prohibited 'intervention', may nonetheless run in contravention of existing law[55]. It is unsettled,

[50] Scholarship and adjudicatory bodies are divided as regards the methodology to identify which choices pertain to the «domaine réservé». See F. Kriener, *Intervention, Prohibition of*, in A. Peters (ed), *Max Planck Encyclopedia of Public International Law*, August 2023, para. 4 ff.

[51] United Nations General Assembly (UNGA), *Declaration on Principles of International Law Concerning Friendly Relations and Co-operation among States in Accordance with the Charter of the United Nations*, A/RES/2625(XXV), 15 December 1970, Annex, para.1, Principle c).

[52] Jamnejad, Wood, *The Principle of Non-Intervention*, cit., p. 348. See also A. Tzanakopoulos, *The Right to be Free from Economic Coercion*, in *Cambridge International & Comparative Law*, 2015, p. 616, at p. 620 (arguing that coercion is the element distinguished prohibited intervention from lawful interference).

[53] Kriener, *Intervention, Prohibition of*, cit., para. 46 ff.

[54] See more extensively R. Buchan, *Cyber Espionage and International Law*, London, 2021.

[55] See for instance *Italian Position Paper on 'International Law and Cyberspace'*, p. 4. See for instance Ministry of Foreign Affairs of the Italian Republic, *Italian Position Paper on 'International Law and Cyberspace'*, 2021, available at <https://www.esteri.it/mae/resource/doc/2021/11/italian_position_paper_on_international_law_and_cyberspace.pdf>, p. 4. *Contra* see UK's reservation to the 2020 NATO Allied Joint Doctrine for

however, whether the same would go for cyber operations resulting in neither physical damage nor loss of functionality[56]. Put differently, it seems that a minimum threshold of gravity, to be demonstrated with regard to the actual harm inflicted, must be met in order for such mere violations of sovereignty to be qualified as unlawful under international law.

At the crossroads of the fourth and the fifth domains, those rules must be applied carefully. As already noted, satellite systems play a crucial role in the everyday life of millions – if not billions – of people: targeting them via cyberattacks may impact on entire populations, which renders them the perfect objective of hybrid tactics. Jamming, spoofing, and other means of disturbance of satellite activities could thus be qualified as intervention in internal or external affairs (proscribed also in space law)[57], and also as forms of interference of sovereignty that, in light of the emerging understanding of international norms applicable in the cyberspace, may constitute an internationally wrongful act.

More to this, it must be kept in mind that international space law already addresses certain forms of interference: for instance, according to Article IX of the OST, any State Party having 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 has a duty to consult with those other States (which in turn have a right to request such consultation)[58]. This rule is also reflected in non-binding instruments[59]. At this point, one may object that, in keeping with

Cyberspace Operations: NATO, Allied Joint Doctrine for Cyberspace Operations, Allied Joined Publication-3.20, January 2020, available at <https://assets.publishing.service.gov.uk/media/5f086ec4d3bf7f2bef137675/doctrine_nato_cyberspace_operations_ajp_3_20_1_.pdf>. For a discussion of this practice, see H. Moynihan, *The Application of International Law to State Cyberattacks*, Chatham House, December 2019, p. 1.

56 M.N. Schmitt (ed), *Tallinn Manual 2.0 on the International Law Applicable to Cyber Operations. Prepared by the International Groups of Experts at the Invitation of the NATO Cooperative Cyber Defence Centre of Excellence*, Cambridge, 2017, Rule 5, p. 21.

57 See R.S. Jakhu, S. Freeland (eds), *McGill Manual on International Law Applicable to Military Uses of Outer Space: Volume I- Rules*, Montreal, 2022, Rule 117 («Space activities, including military space activities, shall be carried out in conformity with the principle of non-intervention under international law»).

58 *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, cit., Art. IX. For a commentary on this prohibition, namely on the notion of «potentially harmful», see S. MARCHISIO, *Article IX*, in S. Hobe et al. (eds), *Cologne Commentary on Space Law. Volume I*, Koln, 2009, p. 556.

59 Jakhu, Freeland (eds), *McGill Manual on International Law Applicable to Military Uses of Outer Space: Volume I- Rules*, cit., Rule 121.

the understanding of hybrid warfare proposed above, activities *willfully* aiming to destabilize opponents in outer space are inherently *covert*: there would be no interest, on the part of a State preparing to launch a hybrid attack against another, to notify its intended activity in advance. The fact that States will not abide by a rule… confirms the existence of such rule; more importantly, it confirms that in outer space explicit rules are in place prohibiting even lower forms of interference in international relations.

More specific rules are set by other international instruments, both binding and non-binding: for instance, in additional to a overarching prohibition on generic «intentional harmful interference»[60], the Constitution of the International Union of Telecommunications provides the Union with the power to act to avoid «harmful interference between radio stations» of different States, and imposes Member States a duty to refrain from causing it (as a *negative* obligation) and to prevent it (as a *positive* one)[61]. This applies undoubtedly also to outer space activities[62].

While those rules are believed to leave considerable scope for discretion to States[63], it must be kept in mind that the reasons behind these rules must be traced back to the fundamental principles regulating States' behavior in outer space, namely the pacific use of it inasmuch as «province of mankind»[64]: legally speaking, basing on rules and principles that were established at the very beginning of space exploration (and that continue to be binding today) the logic of 'genuine cooperation' must prevail over the logic of 'hostile confrontation'.

4.3 *Threat and Use of Force and Aggression (and Self-Defense)*

As stated at the beginning of the present section, the prohibition on the threat and the use of force is one of the bedrock rules of post-1945

[60] Jakhu, Freeland (eds), *McGill Manual on International Law Applicable to Military Uses of Outer Space: Volume I- Rules*, cit., Rule 139.

[61] See *Constitution and Convention of the International Telecommunication Union (with annexes and optional protocol)*, adopted on 22 December 1992, arts. 2, 6, and 45.

[62] Jakhu, Freeland (eds), *McGill Manual on International Law Applicable to Military Uses of Outer Space: Volume I- Rules*, cit., Rules 140-144 (for more detailed rules).

[63] H. Nasu, *Targeting a Satellite: Contrasting Considerations between the Jus ad Bellum and the Jus in Bello*, in *International Law Studies*, 2022, p. 142; M.N. Schmitt, *International Law and Military Operations in Space*, in A. von Bogdandy, R. Wolfrum (eds), *Max Planck Yearbook of United Nations Law*, 2006, p. 89, at p. 105.

[64] *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, cit., Art. I.

international legal order: in addition to being formulated in written, it also stems from the principle of non-intervention, as no one fails to see that using or threatening military force is one of the most intense forms of intervention in other States' internal or external affairs[65].

As far as general international law on the use of force is concerned, the apparently crystal-clear rule enshrined in Article 2(4) of the UN Charter has inspired a multifarious practice of States and international organizations. In particular, the exact content of the prohibition and its boundaries have made the object of heated debates[66]. The ICJ has famously stated that various degrees of force can be identified: it is possible to distinguish «the most grave forms of the use of force (those constituting an armed attack) from other less grave forms»[67].

As a matter of fact, the rule has been held to apply also to threats or uses of force *minoris generis*, that is not only in cases of direct uses of force on the part of one State against another, but also in cases of participation in other state and non-state actors' uses of force[68]. The convincing argument has been put forward that also those cases of minimal (or reduced) use or threat of force be included in the rule, so as to curb States' attempts at finding a justification to their conducts[69]. However, it must be noted that practice so far tends to include in the prohibition under Article 2(4) only military forms of physical force between States; non-military forms, such as massive influx of refugees or economic coercion, or cross-frontier employment of natural forces, do not amount as 'threats or uses' of force, but rather they qualify as violations of the principle of non-intervention or the rule of sovereignty[70]. A partially divergent trend can be registered in the field of cyberattacks, where some commentators (and, importantly,

[65] Kriener, *Intervention, Prohibition of*, cit., paras. 22 ff.

[66] O. Dörr, *Use of Force, Prohibition of*, in R. Wolfrum, *Max Planck Encyclopedia of Public International Law*, cit.

[67] *Military and Paramilitary Activities in and against Nicaragua (Nicaragua v. United States of America)*, cit., para. 191. See also ICJ, *Armed Activities on the Territory of the Congo (Democratic Republic of the Congo v Uganda)*, Judgment of 19 December 2005, paras. 163-165.

[68] In addition to the jurisprudence of the ICJ quoted above, see UNGA, *Declaration on Principles of International Law Concerning Friendly Relations and Co-operation among States in Accordance with the Charter of the United Nations*, cit.

[69] T. Ruys, *The Meaning of «Force» and the Boundaries of the jus ad bellum: Are «Minimal» Uses of Force Excluded from UN Charter Article 2(4)?*, in *American Journal of International Law*, 2014, p. 159.

[70] See Dörr, *Use of Force, Prohibition of*, cit., para. 12.

States) are more willing to accept that attacks intended to cause physical damage to property or injury to persons, as well as disrupting essential infrastructures of a State, may amount to threats or uses of force, even if short of 'armed' force in the traditional sense[71].

Looking at the other side of the spectrum, gravest uses of force may amount to 'armed attack' or 'aggression'. As regards the consequences of such qualification, it is worth recalling at the outset that while violations of the prohibition of the threat and use of force constitute unlawful acts, allowing victim States to adopt countermeasures in accordance with international law, armed attacks allow targeted States to react in individual or collective self-defense pursuant to Article 51 of the UN Charter. Again, qualification of acts as armed attacks is a challenging operation. In the decades following the adoption of the UN Charter, opposite tendencies have emerged: on the one hand, States have strived to interpret the notion extensively, to legitimize armed reactions under the umbrella of self-defense[72]; on the other hand, adjudicatory bodies – the ICJ in the first place – have sponsored a more cautious approach, setting a high bar for a use of force to be considered as 'armed attack' (e.g., in addition to a criterion linked to the gravity of the act, also a specific intention on the part of the alleged attacker)[73]. Reference is often made to the 'scale' and 'effects' of a given conduct[74].

Again, in times of increasing confrontation between States through hybrid tactics, a different understanding of the concept of armed attack – in line with the one outlined above vis-à-vis threats and uses of force – has been advanced. As regards the Tallinn Manual, it is argued that in order for a cyber operation to amount as 'armed attack' the «critical factor» is whether the *effects* of such operation are «analogous to those that would result from an action otherwise qualifying as a kinetic armed attack»[75]. Such theory

---

[71] Roscini, *World Wide Warfare –* Jus ad bellum *and the Use of Cyber Force*, cit., at p. 102 ff.

[72] See the famous analysis conducted by T. Franck, *Who Killed Article 2(4)? or: Changing Norms Governing the Use of Force by States*, in *American Journal of International Law*, 1970, p. 809. This article was replied to by another international lawyer: L. Henkin, *The Reports of the Death of Article 2(4) Are Greatly Exaggerated*, in *American Journal of International Law*, 1971, p. 544.

[73] *Oil Platforms (Islamic Republic of Iran v. United States of America*, Judgment of 6 November 2003, para. 64.

[74] ICJ, *Military and Paramilitary Activities in and against Nicaragua (Nicaragua v. United States of America)*, cit., para. 195.

[75] Schmitt (ed), *Tallinn Manual 2.0 on the International Law Applicable to Cyber Operations. Prepared by the International Groups of Experts at the Invitation of the NATO*

imposing a comparison between kinetic and non-kinetic (or cybernetic) effects has found its way also in NATO official documents. To name one, in 2021 NATO Member States held that «the impact of significant malicious cumulative cyber activities might, in certain circumstances, be considered as amounting to an armed attack», thus leading to the invocation of the collective defense clause contained in Article 5 of the Treaty[76].

Importantly, the same logic has been recently extended to the fourth domain. In the 2022 Strategic Concept, it is expressly argued that «[a] single or cumulative set of malicious cyber activities; or hostile operations to, from, or within space; could reach the level of armed attack»[77]. In other words, different acts that *per se* do not amount to armed attack, if performed within a specific hostile pattern, can be equated to full-scale armed attack justifying self-defense: this theory, referred to as 'accumulation of events theory' or *Nadelsticktaktik*, is gaining traction in the international discourse on contemporary forms of self-defense against armed attacks, interestingly not just those of a hybrid nature[78].

The argument that this paper advances is that this trend is not just particularly dangerous with regard to space activities (as military confrontation up to armed attacks and self-defense actions in that domain risks producing significant and irreparable harm to human activities), but even more troubling from a *legal* standpoint, on the basis of international space norms as they are today. As is known, not only does *jus ad bellum* apply also to outer space, but the OST contains an explicit *renvoi* to that branch of international law[79]. In other words, forms of threats and uses of force – from the less grave to the gravest – that are unlawful on Earth are equally so in outer space.

If applied *telle quelle* to the space domain, the 'accumulation of events theory' as described above may bring about a nightmarish escalation of military confrontation between States. Repeated disturbances to space

Cooperative Cyber Defence Centre of Excellence, cit., Rule 71, at p. 340, 341.

76 *Brussels Summit Communiqué. Issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in Brussels*, 14 June 2021, para. 32.

77 NATO, *2022 Strategic Concept. Adopted by the Heads of State and Government at the NATO Summit in Madrid*, cit., para. 25.

78 In support of the application of this doctrine, see Y. Dinstein, *War, Aggression, and Self-Defence*, Cambridge, 2005, at p. 230; N. Feder, *Reading the U.N. Charter Connotatively: Toward a New Definition of Armed Attack*, in *New York University Journal of International Law and Politics*, 1987, p. 414.

79 *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, cit., art. III.

activities (e.g., via jamming or spoofing, or through kinetic or non-kinetic ASAT), if of a sufficient gravity, may easily escalate from mere violations of sovereignty or of the principle of non-intervention, to violations to the principle of the non-use of force in international relations and even 'armed attack'. This approach risks *de facto* nullifying the cornerstone prohibition contained in Article 2(4) of the UN Charter, the core principles of international space law (primarily, the principle of pacific use of space) and even jeopardizing space activities for years to come.

5. *Paths to Take, Paths to Avoid*

The choice of considering outer space as a domain of hybrid warfare seems irrevocable today, in a period characterized by a troubling escalation between resuscitated 'blocs' of States. ASAT tests, the use of private constellation of satellites by States engaged in armed conflict, the cruciality of space systems for States' economic, social, and military activities have rendered outer space a veritable 'grey area'[80], in which (spacefaring) States may exploit not only technological advances to their own benefit, but also legal loopholes to boost hostile confrontation between them.

It seems interesting, for the purposes of the present contribution, to expand on this latter point. The specific sector of international space law is composed of treaty rules dating back more than sixty years: most of them are wide in scope and vague in content, and they all lack jurisdictional or quasi-jurisdictional mechanisms of control. Such structural characteristics, coupled with the historical period of renewed hostilities between the many 'poles' the World is divided into nowadays, are *de facto* making it implausible to reach a sufficient degree of agreement to adopt new binding law[81]. Hence, 'blocs' of States are seeking refuge in soft law and other political declarations void of binding effect, as well as proposals of

[80] Sari, *Legal Resilience: Just a Warm and Fuzzy Concept?*, cit.; de Zwart, *Hybrid and Grey Zone Operations in Outer Space*, cit.

[81] This point has been discussed vis-à-vis ASAT: Mauri, *Attività di impiego e di* testing *di armi anti-satellite e diritto internazionale*, cit. Interestingly enough, as far as ASAT are concerned, what is happening is that, given the impossibility to adopt an *ad hoc* binding instrument, some States have begun to issue unilateral declarations renouncing or limiting ASAT testing, with a view to inspiring the formation of new customary law. See also E. Carpanelli, *Towards a Ban of Anti-Satellite (ASAT) Weapons Tests? Exploring Possible Pathways in Light of Recent Developments*, in *Hiroshima Hogaku*, 2023, p. 178.

new treaties that will likely lack sufficient participation[82]. For instance, it is worth mentioning that the last Joint Declaration adopted by Russia and China contains a strong condemnation of the transformation of outer space into a «combat domain»[83]. On their part, Western States have labelled Russia's ASAT test of November 2021 as a «irresponsible behaviour in outer space» – and not, interestingly, an «unlawful» one – and called for the adoption of non-binding rules, norms and principles within the UNCOPUOS framework[84].

Such blossoming of soft law and political declarations in the realm of hybrid warfare in outer space seems particularly indicative of the posture of the international community as a whole vis-à-vis the future – or more correctly the *present* – of space activities. States wish to maintain this state of affairs, in which they are relatively free to take action in a perceived 'grey area', as this meets their interests more properly in these times. However, from a strictly legal standpoint, one must not lose sight of the fact that States operate within an international legal order, that is in a system made up of rules and principles. Instead of insisting on the need to develop new law (something that, as stated above, sounds more like a pious declaration of intent), as many commentators tend to do, it seems more useful to stick to old and well-founded principles such as those that animated the formation of the very first core of international space law (namely the principle of pacific use of outer space as «province of mankind») as well as rules of general international law (the respect of sovereignty and the principle of non-intervention) and *jus ad bellum*. And to argue that those rules fail to define key notions and concept, or lack sufficient clarity, does not legally justify any form of hostile confrontation in outer space. This may not be the ultimate antidote to neutralize the escalation risks posed by the rhetoric of hybrid warfare, but at least it helps stay on course in turbulent times.

[82] See for instance the Russian and Chinese *Draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects*, 12 June 2014.

[83] See *Joint statement between the People's Republic of China and the Russian Federation on deepening the comprehensive strategic partnership of coordination for a new era on the occasion of the 75th anniversary of the establishment of diplomatic relations between the two countries*, 16 May 2024, available in English at <https://geopoliticaleconomy.com/2024/05/24/china-russia-joint-statement-new-era-75th-anniversary/>.

[84] *Statement by the High Representative of the Union for Foreign Affairs and Security Policy on behalf of the EU on the Russian Anti-Satellite Test on 15 November 2021*, cit.

Stefania Paladini

The Case for Space Sustainability: Crowded Orbits, Debris Crisis, and Global Space Governance

Summary: 1. The Concept of Space Sustainability – 2. Space Sustainability: Areas of Growing Concern – 3. Global Space Governance & Competing Visions for Space – 4. Going forward: From Earth's Orbits to Cislunar Space. Conclusions.

1. *The Concept of Space Sustainability*

Areas Beyond National Jurisdiction (ABNJ) are regions for which no nation has sole responsibility for management, and which have been, over decades, the object of international treaties aimed at regulating the access to the transboundary resources they contain are susceptible to depletion risks and conflicts over access. This well-known issue defined the 'tragedy of the commons',[1] is the characteristics of a few domains, including outer space, more specifically, the Earth's orbits. The self-interested behaviours and absence of regulatory or ownership frameworks contribute to these challenges, making coordination difficult, intensifying conflicting interests, and obstructing the development and implementation of international regulations.

The existing legal framework for outer space, established by the Five UN Treaties from the 1960s and 1970s[2] is increasingly insufficient and outdated. The Earth's orbits, in particular, are encountering growing challenges.[3] The surge in space objects, including satellites, space stations,

[1] Hardin, G., 1968. The tragedy of the commons: the population problem has no technical solution; it requires a fundamental extension in morality. *science*, *162*(3859), pp.1243-1248.

[2] Migaud, M.R., 2020. Protecting Earth's orbital environment: policy tools for Combating space debris. Space Pol. 52, 101361.

[3] Paladini S., 2023. Unsustainable Wars? The Use of Weapons in Lower Earth Orbit. In: Environmental Injustice and Catastrophe: How Global Insecurities Threaten the Future of Humanity 2023 May 22. De Gruyter.

and non-functional debris, has been accelerated by the commercialization of space and the growth of private companies. This heightened the likelihood of a cascading series of collisions, aka the Kessler Syndrome,[4] which could lead to severe environmental and economic repercussions. International agencies have routinely suggested best practices to prevent this to happen and make the entire space industry more sustainable. Best practices which are, however, neither legally binding nor universally adopted by space players.

To compound the problem is the existence of not one but many definitions of space sustainability, some of them overlapping in the principles they address. According to the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS), "*space sustainability is the ability to conduct space activities indefinitely into the future, ensuring equitable access to the benefits of space exploration and use for peaceful purposes, while preserving the outer space environment for future generations.*"[5]

This definition underscores the dual objectives of promoting the peaceful use of space and safeguarding the space environment, which is a good way to start but hardly a sufficient end point.

There are other definitions of space sustainability, starting from the ones proposed from the space agencies, closely aligned. ESA states that "*space sustainability refers to the responsible use of space to ensure that future generations can continue to benefit from space-based services and activities. This includes managing space debris, preventing collisions, and minimizing the environmental impact of space mission*."[6] NASA echoes it with this statement: "*space sustainability involves the preservation of the outer space environment through the mitigation of space debris, the adoption of best practices for space operations, and international collaboration to ensure the long-term viability of space activities*."[7] Finally, the UK Agency, like ESA, also put the emphasis on "*the benefits of space can be enjoyed by future generations. This requires minimizing the creation of space debris, avoiding harmful interference with*

[4] Kessler, D.J., Cour-Palais, B.G., 1978. Collision frequency of artificial satellites: The creation of a debris belt. Journal of Geophysical Research: Space Physics 83 (A6), 2637–2646; Bastida Virgili, B., Dolado, J.C., Lewis, H.G., et al., 2016. Risk to space sustainability from large constellations of satellites. Acta Astronaut. 126, 154–162.

[5] United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS). (2018). Sustainability guidelines.

[6] ESA. Nd. ESA Sustainability Principles, https://www.esa.int/About_Us/Responsibility_Sustainability/ESA_Sustainability_Principles

[7] NASA. Sd. https://www.nasa.gov/centers-and-facilities/white-sands/sustainability/

the activities of others, and using space resources responsibly."[8]

All these definitions share one main limit, which is an agreed and commonly adopted metrics and targets for space sustainability. There is no set limit on how many satellites can operate in a given orbital region and even the definition of space sustainability is debated; hence, our proposed definition. Some metrics have been adopted (such as the 25-IADC rule or the casualty risk on ground that determines satellite end-of-life) but overall targets for sustainable spacefaring do not yet exist.

In "Space Sustainability: A Roadmap for Scotland", the Scottish Space Agency[9] attempts to get further than that, presenting a framework in three pillars:

I) *Sustainability in Space*: This dimension focuses on ensuring that space activities are environmentally friendly in terms of long-term sustainability, its most pressing concern being, of course, space debris, discussed in the next session.

II) *Sustainability for Space*: this pillar is about the development of sustainable practices and technologies in support of space activities, and resource management, such as what put in place to reduce the carbon footprint and other harmful byproducts (e.g. soot) associated with launching and operating space missions, space situational awareness, and space traffic coordination.

III) *Sustainability from Space*: finally, there are the sustainability efforts that focus on developing space-based technologies and data to support sustainability on planet Earth. Examples include managing natural resources, monitoring climate change, and using Earth observation data for disaster manager.

While these three components are closely linked one to another –with many spillovers—there are some particular areas of concerns that is worth highlighting and where this operative definition serves well the need of the sector.

[8] UKSA. 2022. Government announces package of new measures to drive space sustainability https://www.gov.uk/government/news/government-announces-package-of-new-measures-to-drive-space-sustainability

[9] Scottish Space Agency. (2022). Space Sustainability: A Roadmap for Scotland, https://scottishspace.org/sustainability/

2. *Space Sustainability: Areas of Growing Concern*

2.1 *The Environmental Impact of Rocket Launches*

The environmental impact of rocket launches is one of these sensitive areas.

This is a field of ongoing research, due to the concerns that a higher volume of rocket launch could led to adverse consequences in terms of loss of ozone and other deteriorating factors in the Earth's higher atmospheres. So far, this impact has been limited but if the activities of suborbital flights are due to grow, as the development of space tourism and other commercial activities in LEO (Lower Earth Orbit) seem to predict, than things may rapidly change for the worse, undermining the progress made by the Montreal Protocol in reversing ozone depletion. Polar areas are deemed particularly at risk.

Ozone is not the only area under scrutiny.

Models simulating the global atmospheric composition due to rocket launch and re-entry heating emissions versus 2019 data reveal alarming trends in other areas. Rocket fuels used in the past have long been studied and discussed in terms of dangers and possible mitigation strategies,[10] but even newer, more environmentally minded ones (e.g. hybrid engines such as Virgin Galactic's) are not without issues either.

For instance, black carbon (soot) particles from hybrid rocket emissions "*are a significant concern. These particles are almost five hundred times more efficient at warming the atmosphere than all other sources of soot combined.*"[11]

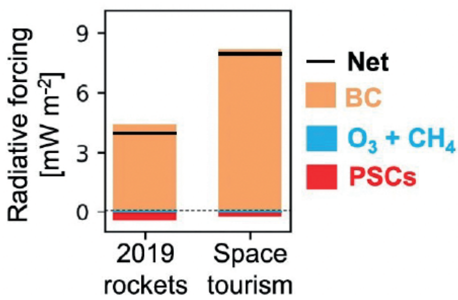

Figure 1 - Effect on rocket launch and re-entry emission (Source: Ryan et al, 2022)

[10] Pultarova, T. (2022). The environmental impact of rocket launches: The 'dirty' and the 'green' https://www.space.com/rocket-launches-environmental-impact

[11] Ryan, R. G., Marais, E. A., Balhatchet, C. J., & Eastham, S. D. (2022). Impact of rocket launch and space debris air pollutant emissions on stratospheric ozone and global climate. *Earth's Future, 10*, e2021EF002612.

According to some models, such as GEOS-Chem 12.9.2, black carbon particles from are almost five hundred times more efficient at warming the atmosphere than all other sources of soot combined, which explains the growing attention to this specific problem.

2.2 *Crowded Orbits and the Debris Crisis*

We might be used to think of space as infinite, and it might well be. Usable orbits however are not.

As the Earth's orbital environment is a finite resource, its capacity needs to be evaluated in terms of the number and type of space objects (not just active satellites but also inactive payloads abandoned by past missions and even rocket bodies) compatible and sustainable in the long term.[12]

This might prove more challenging than what is commonly understood, and the increasing crowding of the orbits constitutes a problem that has been discussed since the 1980s. Space traffic experienced a marked acceleration in 2015, especially in Low Earth Orbits (LEO), which is by far the most crowded of all the orbits, exacerbated by the deployment of large constellations by commercial operators.[13] The swarms of internet satellites such as Starlink and OneWeb are only going to make the issues more acute in the absence of precise regulations.

Another, even more pressing issue in space sustainability is the debris crisis, rightly considered now a real emergency to address.

The proliferation of satellites and space missions over the decades has led to orbits, where, in addition to working satellites, there are the defunct ones, spent rocket stages, and fragments from disintegration, poses significant threats to both operational spacecraft and future missions. Debris increases the risk of collisions and the generation of yet more space debris. This is the well-known 'Kessler effect,' a chain reaction phenomenon, where any additional collision raises exponentially the number of fragments in Earth's orbit.

[12] ESA. (2022). Space Environmental Capacity. ESA: Bruxelles.

[13] UN, 'Guidelines for the long-term sustainability of outer space activities' (2019) A/AC.105/C.1/L.366.

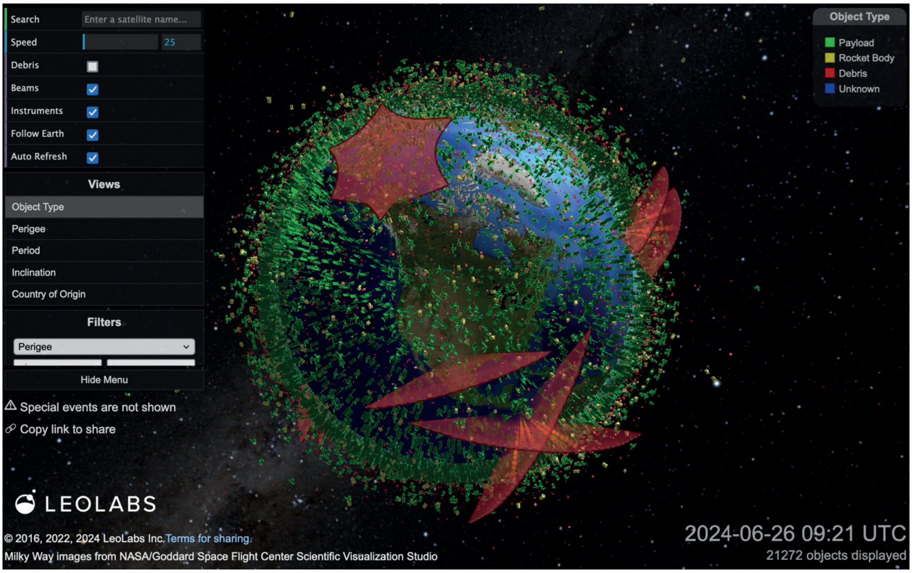

Figure 2 - Simulation in real time of LEO (on 26 June 2024) (Source: LeoLabs Software, 2024)

The United States' Orbital Debris Mitigation Standard Practices (ODMSP), established in 2001, provide a framework for addressing the increase in orbital debris in near-Earth space. However, these guidelines were not designed for operations beyond geosynchronous orbit (GEO).

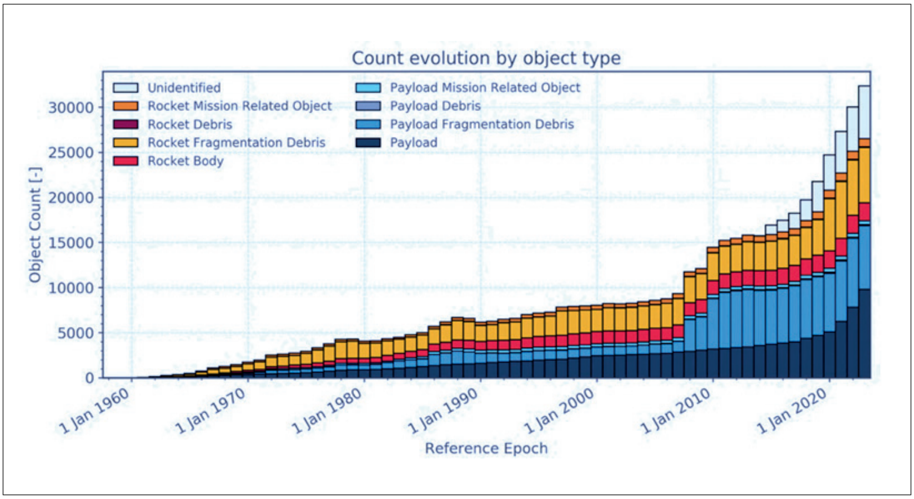

Figure 3 - Objects in Orbit by Reference Epoch (Source: ESA, 2023)

The latest ESA report[14] lists 31990 tracked orbital debris. The actual number of UI (unidentified objects) is higher, i.e., over 1 million objects whose size is larger than 1 cm.[15]

To date, there is no actionable solution to these issues, and, although various mitigation measures are being investigated (including ADR – Active Debris Removal, spearheaded by companies such as Astroscale and ClearSpace) there is still a long way ahead to make them operational.

As human activities extend into cislunar space, it becomes imperative to update these practices to mitigate debris effectively in this broader context (Aerospace Corporation, 2023), as mentioned later in this presentation.

2.3 *Space Tourism*

Last but the least, a contentious point recently emerged in the discussion is space tourism.

Since Dennis Tito's landmark journey as the first private citizen to travel to space, space tourism has transformed from a distant dream into a tangible, albeit elitist, reality. However, the advent of space tourism brings along critical questions about its impact and sustainability. The environmental consequences of frequent space tourism launches can be dire – as the abovementioned study by Ryan et al. (2022) has shown.

Other challenges exist: The European Space Agency defines space tourism as an "*activity that will encompass the execution of suborbital flights by privately-funded and/or privately-operated vehicles and the associated technology development driven by the space tourism market.*"[16] However, from a legal point of view, there is still no legal counterpart to ESA's industry definition of a space tourist,[17] which makes it challenging to design a regulatory framework.

---

[14] ESA, 'ESA's Annual Space Environment Report' (12 Sep 2023) GEN-DB-LOG-00288-OPS-SD <https://www.esa.int/Space_Safety/Space_Debris/ESA_s_Space_Environment_Report_2022> accessed: 3 Mar 2023. The statistics have been updated on 22 Dec /2022.

[15] To which we must add about 130 million space debris objects from greater than 1 mm to 1 cm, estimated by the ESA model. As a whole, UIs are far more dangerous to existing satellites and space stations than the others, because they travel at very high speed (up to 17,500 mph) and, being untracked, it is very difficult to preview collisions and perform avoiding collision manoeuvres.

[16] ESA. (2008). Space tourism. http://www.esa.int/esapub/bulletin/bulletin135/bul135c_galvez.pdf.

[17] Failat, Y. A. (2012). Space tourism: A synopsis in its legal challenges. *ILJ*, 1, 120.

There is the particularly problematic point whether space tourism should even be a thing to pursue in the first place. Williamson[18] points out the ethical dilemma for commercial space exploration; others point out issues of equality of access and social justice,[19] while Peeters[20] questions the moral ground of using scarce planetary resources for non-scientific space travel. Health and safety issues of tourists in space[21] and equality of access and of gains from space activities[22] are other important areas of discussion, which are all going to compound the more general debate about the sustainability of space tourism as a whole.

3. *Global Space Governance & Competing Visions for Space*

Global space governance -often mentioned, but rarely defined and even less clarified and stated in its practical implication – is going to be crucial for ensuring that space activities are conducted in a manner sustainable and beneficial for all the countries. The United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) cannot but represent a starting point. It is not a roadmap and even less a final destination.

Everybody agrees that space is a resource of immense value for Earth in terms of technological advancements, scientific discoveries, and economic opportunities and that, to harness these benefits, it is essential to adopt a vision that prioritizes the long-term health of the space environment. When it comes to implementation, however, the roads start to diverge.

Different countries have different, often competing visions for the future of space, reflecting their unique priorities and strategic interests.

The United States, Europe, Japan, China, Russia, and India all have

[18] Williamson, M. (2003). Space ethics and protection of the space environment. *Space Policy*, 19(1), 47–52.

[19] Aganaba-Jeanty, T. (2015). Common benefit from a perspective of "non-traditional partners": A proposed agenda to address the status quo in global space governance. *Acta Astronautica*, 117, 172–183.

[20] Peeters, P. (2018). Why space tourism will not be part of sustainable tourism. *Tourism Recreation Research*, 43(4), 540–543.

[21] Lyall, F. (2010). Who is an astronaut? The inadequacy of current international law. *Acta Astronautica*, 66(11–12), 1613–1617; Marsh, M. (2006). Ethical and medical dilemmas of space tourism. *Advances in Space Research*, 37(9), 1823–1827.

[22] Toivonen, A. (2020). Sustainability dimensions in space tourism: The case of Finland. *Journal of Sustainable Tourism*, 1–17, 2223–2239

active space programs with distinct goals, and this diversity of perspectives makes international cooperation to managing space sustainably essential and challenging at the same time. The ongoing debate underscores the need for a regulatory framework that accommodates these differing visions while promoting common goals of sustainability and peaceful use.

The recent INMARSAT report[23] highlights how differently different countries look at space, with different concerns and visions depending on the nationality of the respondent, the demographic and the level of instruction. Understanding and keep in mind these different perspectives and aspiration will be key to reach any type of space governance with possibility of success.

4. *Going forward: From Earth's Orbits to Cislunar Space. Conclusions*

The January 2023 Virgin Orbit's launch failure[24], which led to the company filing for Art 11 bankruptcy protection, is a reminder that space is a harsh environment and any advance in technology is paved by difficulties when not disasters. Still, there have never been so many opportunities before. Occasional failures apart, the 2020s promise to bring amazing results, with humanity racing to return to lunar soil, two space stations in Earth orbit, and an ambitious space exploration program with more and more countries. Many, if not all, of these missions, will see private-public partnerships along the lines that have emerged over the past decade and that seem to be the best possible solution to take the space industry as a whole to the next level.

The transition from Earth's orbits to cislunar space— the region extending from Earth's atmosphere to just beyond the Moon— introduces new challenges and opportunities. The Aerospace Corporation conducted a cislunar-focused review in 2023, examining three foundational documents on space-debris mitigation, disposal, and safety of flight. The study found that many aspects of operating in the cislunar regime are incompatible with

23 INMARSAT Report. (2022). The value of space: Technological advancements and economic opportunities.

24 Joey Roulette, 'Richard Branson's satellite launching firm Virgin Orbit files for bankruptcy protection' (*SkyNews*. 4 Apr 2023) <https://news.sky.com/story/richard-bransons-satellite-launching-firm-virgin-orbit-files-for-bankruptcy-protection-12849520> accessed 4 Apr 2023.

current guidelines and requirements[25].

All this highlights the urgent need to address the many sustainability issues in the Earth's orbits to prevent exporting these issues to cislunar space. Effective mitigation strategies and updated regulatory frameworks are crucial for ensuring the sustainability of both near-Earth and farther ahead. The consensus required to make it happen will prove fundamental to start all the other problematic points, to make sure space truly comes to represent that 'province of mankind' it was always supposed to be.

[25] The Aerospace Corporation. (2023). Cislunar-focused review of space-debris mitigation, disposal, and safety of flight documents.

Marco Pedrazzi

Liability for Damage Caused by Space Objects: The Interplay between International and National Law

Summary: 1. Premise: the international liability regime – 2. State liability for damage caused by private operators and the role of national laws – 3. The alternative role of domestic liability regimes – 4. Problems relating to the compensation of private claims – 5. Questions related to redress by the State in whose territory damage was sustained – 6. Solutions in case of in-orbit transfer of the space object.

1. *Premise: the international liability regime*

As known, international space law provides, through Article VII, Outer Space Treaty (OST), and the 1972 Liability Convention (LC), for a liability regime for damage caused by space objects which operates at the level of public international law, and not of domestic law, based on which the *launching State*[1] is liable towards a State which has suffered damage, or which is claiming on the part of physical or juridical persons who have suffered damage[2]. The approach is therefore different from the usual path followed by international conventions dealing with other kinds of dangerous activities (such as, among others, damage caused by aircraft on the surface of the earth[3]), whereby States parties are requested to implement a domestic liability regime of operator's liability. On the contrary, the space liability regime does not require implementation in domestic legislation[4],

[1] The concept will be developed in paragraph 2, below.

[2] There is extensive literature on the topic. For a brief survey and further references, see M. Pedrazzi, *Outer Space, Liability for Damage*, in *Max Planck Encyclopedia of Public International Law*, 2008, www.mpil.de.

[3] See the *Convention on damage caused by foreign aircraft to third parties on the surface*, opened for signature in Rome on 7 October 1952, in 310 *UNTS* 1958, p. 182.

[4] See R.L. Spencer, Jr., *International Space Law: A Basis for National Regulation*, in R.S. Jakhu (ed.), *National Regulation of Space Activities*, Dordrecht, 2010, p. 1, p. 9.

subject to a *caveat* that I will develop further on, as the launching State is liable in any case.

Nonetheless, this regime may interfere with domestic legislation at various levels, and domestic legislation in connection with such liability, although not necessary, is all the same advisable. The purpose of this contribution is to briefly consider some of these aspects, without any claim of completeness.

2. *State liability for damage caused by private operators and the role of national laws*

To start dealing with the interplay between international and national law, it is necessary, however, to say something about the scope of the international liability regime, in particular in relation to private operators of space objects. In fact, there is no doubt that the State is liable not only for damage caused by its space objects, but also for damage caused by private space objects.

The LC (Art. II and following) identifies the launching State as the State liable for damage caused by a space object. The launching State is defined in Art. I(c) based on four alternative criteria:

i) the State which launches;

ii) the State which procures the launching;

iii) the State from whose territory the launching takes place;

iv) the State from whose facility the launching takes place.

The same classification was already used in Art. VII, OST, although there the expression 'launching State' did not appear[5]. Provided that each of these criteria may be relevant and that, taken altogether, they may lead in certain cases to identify multiple launching States, there is one criterion that is overtly paramount when we consider private space activities: the State from whose territory the space object is launched. It is paramount because the great majority of space objects are launched from the territory of a State, and in many cases this is also the State to which the object, and the operator, are most connected. This means that, based on the territorial

[5] See A. Kerrest and L.J. Smith, *Article VII*, in S. Hobe, B. Schmidt-Tedd, K.-U. Schrogl (eds.), *Cologne Commentary on Space Law*, vol. 1, *Outer Space Treaty*, Cologne, 2009, p. 126, p. 136 and ff. The 1968 *Astronaut Agreement* would use the term 'launching authority'.

criterion, in case of damage, for the great majority of private space objects at least one State would be liable.

But we need to consider whether a State would be liable according to other criteria: the answer to this question is necessary to solve cases of launches from the high seas, from international airspace or from the International Space Station (ISS), but also to identify other possible launching, and liable, States apart from the territorial State. Well, in the specific cases of launch from a ship or aircraft, these could be considered as facilities belonging to their national State (i.e. the State in which they are registered). Alternatively, the territorial State from which the aircraft's take-off has taken place could be considered as the State from which the launching has taken place. More importantly, according to some, the national State of the person or company undertaking the launch could be qualified as the *State procuring the launch*, especially in the case in which that State, in compliance with Article VI, OST, had licensed the activity in question[6].

In my view, and in the view of most commentators, the effect of Article VI, OST, is to *attribute* private space activities to the national State: therefore, if a private operator launches a space object, from wherever the launch takes place, the operator's national State qualifies as the *State which launches* the space object. Which means that not only the territorial State, but also the national State are automatically *launching States*. This is certainly true for the States parties to the OST. Now, we need to consider that the great majority of States active in space, or whose nationals are active in space, are parties to the OST. Personally, I would consider that the main OST provisions, including Article VI, have entered the field of customary international law[7]. Therefore, the above conclusion would be valid for all States.

There remains one case to be considered: that of a private entity *procuring the launch* of a space object. Applying the same concepts indicated before, I would consider that also in this case the national State is procuring the launch, as the private operator's activity would be attributed to the national State. One has to verify what national laws provide in these cases. The French law provides, for example, that authorization is needed by:

> "Any natural person having French nationality or juridical person whose headquarters are located in France, whether it is an operator or not, intending to procure the launching of a space object or any

[6] See, among others, T. Masson-Zwaan, M. Hofmann, *Introduction to Space Law*, 4th ed., Alphen aan den Rijn, 2019, p. 27.

[7] See, among others, B.B.Y. Keskin, *Tracking the Evolution of Customary Rules in International Space Law*, in *Journal of Space Law*, 2022, p. 180 and ff., p. 194.

> French operator intending to command such an object during its journey in outer space"[8].

Obviously, the provision of authorisation, in compliance with Article VI OST, does not necessarily imply that France considers itself as the *launching State* in these cases, and therefore does not necessarily amount to acceptance of liability for damage caused by the authorised activity. Nonetheless, it is a signal that the State is conscious that it might be called to respond, in a way or another, including liability for damage. The truth is that one must be very cautious in inferring from national law either the interpretation of a treaty, which could contribute to a subsequent practice capable of influencing interpretation at the international level (see Article 31.3(b), Vienna Convention on the Law of Treaties), and even more, practice and *opinio juris* possibly contributing to the formation of customary international law. The fact that a State legislates on the appropriation of celestial bodies' resources may be a good indication that it considers such appropriation as internationally lawful (or wishes to promote its lawfulness); but the fact of providing authorisation for a certain activity could just signify the will to control that activity, while it does not necessarily imply that the State considers to be bound to issue such an authorisation or that it considers that it would be liable for any damage caused by that activity.

Now, while the co-existence of multiple launching and liable States can only be solved by means of an international agreement among them (due to joint and several liability, under Article V LC, solved will mean that each of A, B and C may be called to pay, but that the one who pays may be granted the right to claim reimbursement of either a part or the whole from the others)[9], it is in the interest of the launching State of private

[8] Loi n° 2008-518 du 3 juin 2008 relative aux opérations spatiales, Article 2 : « Doit préalablement obtenir une autorisation délivrée par l'autorité administrative : … 3° Toute personne physique possédant la nationalité française ou personne morale ayant son siège en France, qu'elle soit ou non opérateur, qui entend faire procéder au lancement d'un objet spatial ou tout opérateur français qui entend assurer la maîtrise d'un tel objet ou d'un groupe d'objets spatiaux coordonnés pendant son séjour dans l'espace extra-atmosphérique ». The unofficial English translation is taken from the *Journal of Space Law*, 2008, p. 453 and ff. The original version here reproduced is the result of later amendments.

[9] See L.J. Smith, A. Kerrest, *Article V (Joint Launch/Joint and Several Liability)*, in S. Hobe, B. Schmidt-Tedd, K.-U. Schrogl (eds.), *Cologne Commentary on Space Law*, vol. II, *Rescue Agreement, Liability Convention, Registration Convention, Moon Agreement*, Cologne, 2013, p. 141 and ff., p. 145 and f.; A. Kerrest, *The Concept of the 'Launching State' in Commercial Launch Ventures*, in J. Wouters, P. De Man, R. Hansen (eds.), *Commercial Uses of Space and Space Tourism. Legal and Policy Aspects*, Cheltenham (UK), 2017, p. 3 and ff., p. 6.

space objects to provide in its domestic legislation for the possibility for the State to obtain the full or partial recovery of the burden of compensation paid by it from the private operator. Here, in fact, the State faces two competing interests: that of avoiding financial losses due to the action of a private party, and that of supporting private space industries. The two diverging interests may be composed by imposing a cap to the amount of money that may be recovered from the private company, and at the same time an obligation of insurance, up to the cap's limit. The State, in the end, will keep its loss as far as the amount of compensation exceeding the cap is concerned (exceptions may be provided in case of violations of the provisions of the law committed by the private party: in this sense, the Belgian law, Articles 15 § 4, 16 § 2, 19 § 3[10]; French law, Article 14, in case of wilful misconduct). Such kind of provisions are included in most national laws[11]. One should also recall the recommendation contained in the 2013 resolution of the General Assembly of the United Nations containing "Recommendations on national legislation relevant to the peaceful exploration and use of outer space"[12]:

> "7. States could consider ways of seeking recourse from operators or owners of space objects if their liability for damage under the United Nations treaties on outer space has become engaged; in order to ensure appropriate coverage for damage claims, States could introduce insurance requirements and indemnification procedures, as appropriate".

A national legislation is required to deal with all these aspects.

3. *The alternative role of domestic liability regimes*

One has to notice, furthermore, that international liability, as devised by the OST and the LC, is not exclusive. According to Article XI.2 LC:

> "Nothing in this Convention shall prevent a State, or natural or juridical persons it might represent, from pursuing a claim in the

[10] Law of 17 September 2005 on the Activities of Launching, Flight Operation or Guidance of Space Objects, consolidated text as revised by the Law of 1 December 2013. The English translation is available at https://www.belspo.be/belspo/space/doc/belaw/Loi_en.pdf.

[11] See A. Kerrest, *The Concept of the 'Launching State'*, fn. 9 above, p. 13 and ff.

[12] UNGA Res. 68/74 of 11 December 2013.

> courts or administrative tribunals or agencies of a launching State. A State shall not, however, be entitled to present a claim under this Convention in respect of the same damage for which a claim is being pursued in the courts or administrative tribunals or agencies of a launching State or under another international agreement which is binding on the States concerned".

This norm has two implications: first, that it is possible for the State to provide for a domestic system of operator's liability; second, that the choice of the domestic claim excludes the other, or, in other words, *electa una via non datur recursus ad alteram*. To specify better, the introduction of the international claim (for which no prior exhaustion of domestic remedies is required) will not prevent from starting a claim before a national court, unless such a preclusion is contemplated by national law. But the introduction of the national claim will obstruct the way for the international claim: in practical terms, that will be once and for all, as, considering the normal times of domestic justice and the fact that, under Article X LC, the international claim "may be presented to a launching State not later than one year following the date of the occurrence of the damage or the identification of the launching State which is liable", it is highly unlikely that the national proceedings will be concluded before this deadline[13].

As to the nature and characters of the domestic liability, it may fall under the general regime of tort liability, or under a specific regime regulating liability for damage caused by space objects.

One has to add that the international regime excludes damage caused by the space object to nationals of the launching State and foreign nationals participating in the operation of the space object, or present in the immediate vicinity of a planned launching or recovery area as the result of an invitation by the launching State (Article VII LC). Passenger liability is equally excluded. These typologies of damage need to be covered by national law.

One should also notice that, in transnational situations, such as those that fall under the international space liability regime, the national court will have to verify whether it has jurisdiction based on the applicable rules of international civil procedure, and the national law called to rule the case will be determined by the applicable conflict of laws rules[14].

[13] See A. Kerrest, *The Concept of the 'Launching State'*, fn. 9 above, p. 10.

[14] For further considerations, see L.J. Smith and A. Kerrest, *Article XI (Relation to National Jurisdiction)*, in S. Hobe, B. Schmidt-Tedd, K.-U. Schrogl (eds.), *Cologne Commentary on Space Law*, vol. II, p. 166 and ff., p. 168 and f.

4. *Problems relating to the compensation of private claims*

I would claim that a further level of implementation *is* required by the OST and LC: as, in the case of damage suffered by natural or juridical persons, compensation is meant to cover *their* damage, and not the damage suffered by the State introducing the claim (as it would be according to the traditional doctrine of diplomatic protection), national provisions are necessary, either *ad hoc* or already present or implicit in the domestic legal system, to guarantee that when the State claims and obtains compensation on behalf of such persons, this compensation will effectively reach the victims[15].

5. *Questions related to redress by the State in whose territory damage was sustained*

National laws may, further, provide for redress to citizens or foreigners suffering damage caused by foreign space objects, even in the absence of a successful international claim on the part of the State. This is, in part, the case of the Italian legislation. Italy is one of the few important space powers still lacking a proper national space law[16], however it has adopted a few sparse norms. The one relevant here is contained in Law No. 23 of 25 January 1983, based on which the Italian State will compensate Italian victims of damage caused by a space object launched by a foreign launching State, not only in the case in which the Italian State has obtained compensation from the launching State, but also in case the Italian State

[15] See, by contrast, the mere recommendation contained in Article 19(c) of the *Draft Articles on Diplomatic Protection* approved by the International Law Commission (ILC) in 2006, whereby a State entitled to exercise diplomatic protection "should … transfer to the injured person any compensation obtained for the injury from the responsible State subject to any reasonable deductions" (ILC, Report of the 58th session, UN Doc. A/61/10, in *Yearbook of the International Law Commission*, 2006, vol. II, Part Two). The State entitled to present to the launching State a claim for compensation on behalf of the victims is identified by Article VIII, LC, on which see L.J. Smith and A. Kerrest, *Article VIII (Eligibility of Claimant States)*, *ibid.*, p. 154 and ff.

[16] This situation should change in a short time, as the Italian Council of ministers has approved, on 20 June 2024, the text of a Draft Space Law that has been submitted to Parliament for adoption. See Atti Parlamentari, Camera dei Deputati, XIX legislatura, Ddl No. 2026, *Disposizioni in materia di economia dello spazio*, introduced on 10 September 2024. For a brief overview see M. Galli, *Italy on the Moon. 'DDL Spazio': a boost for the Space Economy, Legal alert*, 9 September 2024 (https://pglex.it/wp-content/uploads/2024/09/PGLEX-Legal-Alert_DDL-Spazio_09.09.2024_ENG.pdf).

has not claimed compensation, unless this has been obtained either by the State in whose territory the damage has been sustained or by the State of the victims' personal residence, based on Article VIII.2 and 3 LC, or it has claimed but not obtained compensation. On the contrary, foreign victims may obtain compensation from the Italian State in the last two instances only if the Italian State has claimed and obtained compensation from the launching State. I will not consider here the possible problematic aspects of discrimination inherent in such legislation, in particular in light of EU law.

6. *Solutions in case of in-orbit transfer of the space object*

A further problem which may arise, and may affect the liability issue, is the transfer of property and control of a space object in orbit. No doubt that the national State of the transferee, if different from the national State of the transferor, will become the/a responsible State based on Article VI OST[17]. The liability aspect is more complicated, because the transferee's national State is not necessarily a launching State: unless the object were transferred onto its national space registry, which, could be argued, would render it automatically a launching State, as, according to Article II of the Registration Convention (RC), the obligation to register falls on the launching State. Although, in this case, the State of registry would not correspond to any of the criteria qualifying a launching State. However, the RC does not provide for re-registration of a space object[18]. But we could consider the case of a space object whose property is transferred *before* registration has taken place, and that is then registered directly by the new owner's national State.

In any event, the previous launching State, which will remain a launching State, may include relevant provisions in its national law, such as the one introduced by Belgium in Article 13 § 5 of its national law:

> "When the transferee operator is not established in Belgium, the Minister may refuse the authorisation in the absence of a specific agreement with the home State of the third party in question and which indemnifies the Belgian State against any recourse against it under its international liabilities or claims for damages".

[17] See M. Gerhard, *Article VI*, in S. Hobe, B. Schmidt-Tedd, K.-U. Schrogl (eds.), *Cologne Commentary on Space Law*, vol. 1, p. 103 and ff., p. 124 and f.

[18] See A. Kerrest, *The Concept of the 'Launching State'*, fn. 9 above, p. 6.

These are, therefore, some of the problems that shall, or should, or may be addressed in deciding whether and how to legislate at the national level. They do not address all issues: one that I have left apart, but which is quite relevant, is that relating to product liability, which, absent international rules, is entirely left to national legislation.

Purvi Pokhariyal, Deepa Dubey

India's Strategic Roadmap in International Space Law: Critical Analysis

Summary: 1. Introduction – 2. India's space policy: critical insight – 3. Overview of space policy – 4. Comparative analysis of previous policies – 5. Economic impact of space activities – 6. Market opportunities and potential growth areas – 7. Commercialisation of outer space – 8. Space debris – 9. India's outer space regime – 10. The current international legal standing – 11. Conclusion.

1. *Introduction*

The science that underpins the Indian Space Programme (ISP) has a "indigeneity" to it since its start. The term "Indigenous science" refers to a country's cultural features that lead to a refusal to share territories invaded by mainstream Western research. Pioneers of Indian space science, such as Vikram Sarabhai and Satish Dhawan, and later A.PJ. Abdul Kalam, envisioned and implemented a space program for India based on scientific self-sufficiency via localized advanced technology. Their clear approach described space technology as a tool to aid mankind's collective self-development. They put technology at the service of humanity, in stark contrast to Western science's totalizing mindset. However, does India's current space plan adequately reflect its indigenous sciences? Or does it more closely resemble international space law (a Western invention founded on a war-and-peace paradigm), in sharp contrast to the ISP's lofty goals? Considerations like these cannot be ignored, especially as India develops national space policy.

The objectivity of science is broadly accepted. Furthermore, little consideration has been given to the notion that scientific objectivity is protected by societal considerations. Such a social nature of science necessitates the consideration of human well-being in the world.[1]

[1] H. E. Longino, *Science as Social Knowledge: Values and Objectivity* in *Scientific Inquiry*

Perhaps the social aspect of science is a topic of discussion among the few scientists who like self-infliction. However, a small number of sceptics, who could be labelled as "sinners of science," have accepted the absoluteness of science as a given, a self-reference. As a result, they look for science in cultural diversity—the science of "such-and-such" culture, the science of "such-and-such civilization." But then there's the great Western science, which has wrongly claimed to be the-science while totalizing (and colonising) all other disciplines. On that basis, the "the-science" clean image of Western science asserts that it possesses the tools to discover truth. However, this argument can only be discovered by conquering other scientific approaches, which frequently work in the name of human growth. Michel Serres describes "the-science" as instilling "the unbearable pride of a possessive and domineering science," as well as a "arrogance" that contrasts with a committed joy for learning about nature.[2] The idea of "the science" is harmful[3].

"The science" has utilised violence to achieve its desired outcome. The organization's claims of standing for global peace mask its violent actions, resulting in a war-peace framework that promotes peace through conflict. To assure human well-being, "the-science" kills hundreds of thousands of "lesser animals," including frogs, rats, and pigs, which bleed on lab tables.' To promote human progress on this world, "the-science" has vandalised nature, eradicating forests, rivers, and mountains to provide humanity with comfortable environments. Construction of dams and hydroelectric projects has ruined valleys, livelihoods, and downstream ecosystems. To ensure world peace, "the-science" has participated in dropping bombs to eliminate anybody who opposes peace. Whatever neutrality "the-science" claims is a fraud. According to Shiv Viswanathan, science may either be hijacked by politics or become a source of societal influence.[4]

Let us focus on the first of Visvanathan's two statements: science, which is otherwise calm and pacified, is corrupted by aggressive political forces in the social world. Ashish Nandy has a similar take on the politicisation of

3-14, 66-69 (1990).

[2] C. Larrère, *Ethics, Politics, Science, and the Environment: Concerning the Natural Contract*, in *Earth Summit Ethics: Toward a Reconstructive Postmodern Philosophy of Environmental Education* 115, 120 (J. Baird Callicott & Fernando J.R. da Rocha eds., 1996).

[3] S. G. Sreejith, *Unmaking National Space Legislation for India: Indigenizing Space Law Through the Organic Science of the Indian Space Program*, 83 *J. Air L. & Com.* 109-144 (2018).

[4] R. Sood, *An Indian Space Law: Long Overdue*, *ORF Online* (Mar. 31, 2020), available at https://www.orfonline.org/research/indian-space-law-long-overdue-54867/.

science: "May the sources of violence [in science] lie partly in the nature of science itself?" Is there something about modern science that makes it particularly vulnerable to cooperation by the powerful and wealthy?" Perhaps, yes. Science has been viewed as a tool for self-indulgence, with the potential to perpetuate hedonism worldwide. Perhaps the consistency of science with sensuous self-indulgence, as well as the promise of material joy, led to science becoming a political tool.[5] Spacecraft launch and operation, space technology design and manufacture, and space exploration and research are all overseen by both the private and public sector. Such states can successfully commercialise their resources while being protected from international space law inadequacies. Before delving into the existing legislation governing space activities in India, this paper attempted to provide a brief overview of recent developments in India's space programme, assess the role of private entities in the space sector, illustrate the fields of the space sector, and summarize the international legal framework for space.

2. *India's space policy: critical insight*

The Indian Space Policy 2023 was unveiled last year after receiving approval from the Cabinet Committee on Security on April 6, 2023.[6] The policy aims to achieve two main objectives. First, it describes the roles of major Indian space organizations such as the Indian Space Research Organisation (ISRO) and New Space India Limited (NSIL)[7] in promoting space technology research and development in the government sector. Secondly, it encourages the private sector's active participation and contribution to India's growth.

India has already made enormous success in the space sector, and the government is currently focusing on more development and expansion in

---

5 H. E. Longino, *Science as Social Knowledge: Values and Objectivity* in *Scientific Inquiry* 3-14, 66-69 (1990).

6 Department of Space, Government of India, *Indian Space Policy 2023*, available at https://www.isro.gov.in/media_isro/pdf/IndianSpacePolicy2023.pdf. (accessed July 2, 2024).

7 T. E. Narasimhan, *Isro's New Commercial Arm NewSpace India Officially Inaugurated,* Smart Investor (May 24, 2019), https://web.archive.org/web/20190827142458/https://smartinvestor.business-standard.com/markets/Marketnews-5844097-Stock_Updates-Isros_new_commercial_arm_NewSpace_India_officially_inaugurated.htm (accessed July 4, 2024).

this field. Overall, India's principal purpose and desire in implementing this plan is to leverage the country's unique experience and technical know-how in this field. Let's look at some data to understand the scenario better. Today, the global space economy is worth USD 400 billion. India constitutes about 2% of the global space industry, which amounts to 10 billion USD.[8] Long ago, Indian scientists recognised the potential and importance of developing rocket technology. Indeed, considering India's large population, efforts to establish a space research and development organisation began as soon as the country gained independence. Many outstanding historical figures deserve significant credit. Without Vikram Sarabhai, the Indian space industry would not have reached its current magnitude. He established the Indian space programme and was a scientific visionary. Homi Bhabha, also known as the "Father of India's Atomic Programme," was the Department of Atomic Energy director. The INCOSPAR programme established the Indian Space Research Organisation (ISRO) in 1969, which was a watershed moment, with Dr. Sarabhai serving as its first chairman.

As time passed, the USSR and the United States emerged as global space heavyweights, starting the well-known 'Space Race' between the two countries. Against this backdrop, India began developing satellite technology to meet future remote sensing and communication needs. In 1975, India launched its first satellite, Aryabhata. Only a few years later, in 1980, India launched its first handmade satellite, the Rohini-1.

India successfully launched its first ASLV, the ASLV-D3, on its third attempt in 1992, followed by its first PSLV in 1994. In 2001, India successfully launched its first GSLV, which is still the most powerful Indian launch vehicle in service today. ISRO's most important job is to continue the Lunar Exploration Space Programme. From Chandrayaan-1, the mission's initial flight in 2008, until Chandrayaan-3, was launched on July 14, 2023. ISRO is currently building the Aditya-L1 spacecraft to explore the solar atmosphere. While in orbit around the Sun-Earth L1 Lagrange point, it will investigate the solar atmosphere and its effects on Earth.[9] The Indian Space Policy 2023 is critical to the growth of the space industry because it has the ability to pave the path for the advancement of space activities necessary to better human understanding of space. The reason for this is ISRO's growing interest in studying the complexities of space sector exploration. Following that, new space technologies and applications will

[8] Department of Space, Government of India, *Opening Up Space*, available at https://www.isro.gov.in/g20selm/assets/img/PDF/OpeningupSpace.pdf.

[9] A. Sharma, *Economic Analysis of Indian Space Policy* 2023, 4 *JUS CORPUS L.J.* 29 (2023).

be created to improve space infrastructure and capacity.

The Indian Space Policy 2023 is crucial to the evolution of the space sector because it has the potential to pave the way for the advancement of space activities that are required to improve human understanding of space. The reason for this is ISRO's increased interest in researching the intricacies of space exploration. Following that, new space technologies and applications will be developed to help boost space infrastructure and capability.

Furthermore, the policy is critical because it focuses on increasing India's commercial footprint in space. Furthermore, India has the potential to become a dominant force in the integration of space technology and the economy, which might have far-reaching implications for India in international affairs. The policy also seeks to boost private sector participation in space. It is crucial due to the various worldwide precedents that private companies have set in the space business. For example, in 2020, SpaceX launched its Falcon 9,[10] a reusable rocket, signifying a major milestone as the inaugural private crewed mission to the International Space Station. Private enterprises can assist India in maintaining competitiveness within the burgeoning space industry. Moreover, private participation is gaining significance as private entities exhibit greater adaptability in their operations compared to governmental organizations, as they are not bound by external regulations and can respond more swiftly and effectively to technological innovations and evolving consumer preferences.

This policy would offer essential clarity for space reforms, facilitating the nation's advantage in the space industry. Overall, the 2023 policy is a critical document that will guide and affect India's space sector in the next years. The policy has several components. The policy strongly emphasizes the roles of specific space entities, allowing the private sector to participate and contribute actively. These are the Indian National Space Promotion and Authorization Centre[11] (hereinafter referred to as 'InSpace') and the Department of Space.[12] (hence referred to as 'DOS'), and the NSIL. This is exceptional since, according to the policy's job division, these institutions will now engage in space activities formerly reserved for ISRO.

---

[10] *'Falcon 9 - First Orbital Class Rocket Capable of Reflight'* (SpaceX), https://sma.nasa.gov/LaunchVehicle/falcon9.html#:~:text=Falcon%209%20is%20the%20first,(RP%2D1)%20propellant (accessed June. 10, 2024).

[11] *In-Space to Be New Space Industry Regulator, Says ISRO Chief Sivan, The Hindu* (June 6, 2020), https://www.thehindu.com/sci-tech/science/new-space-industry-body-inspace-to-be-in-place-in-3-6-months-ksivan/article31718441.ece (accessed June. 24, 2024).

[12] DOS Structure, *ISRO*, https://web.archive.org/web/20140927110830/http://dos.gov.in/structure.aspx (accessed Mar. 23, 2023).

InSpace, as the principal authority for space launches, will assist with launch pad testing, satellite operations, data transmission through high-resolution imagery and remote sensing technologies, along with additional responsibilities. The institute will not only ascertain optimal utilization of India's space resources and enhance space-based operations but will also serve as an intermediary between ISRO and commercial enterprises. NSIL will be accountable for the production, assembly, and integration of the launch vehicle. It will collaborate with the private sector to transfer miniature satellite technology to the space industry, produce SSLVs and PSLVs, and create and commercialize space-based products and services, encompassing their launch and utilization. The Department of Space will supervise the Indian space program. It will supervise agencies and institutions engaged in space exploration and technology, including ISRO, NSIL, InSpace, and others. It will offer overarching policy directives and function as the central authority for the execution of space technology, alongside facilitating international collaboration and coordination in the realm of global space governance and initiatives.

3. *Overview of space policy*

The space sector has been highlighted as an area for developing low-cost satellites, and this year, all eyes are on India and its space industry. Against this backdrop, the 2023 policy has been established as the optimum combination of public-private partnership in the space sector. Let us look at how the policy's provisions can contribute to the development of space industry standards. The main reason is that the policy recognizes and promotes vital space missions like lunar orbital cap exploration and solar atmosphere research. It also encourages engagement with academia to strengthen industry-academia relations. ISRO, the world's sixth-largest space organization, has been tasked with developing and utilizing space technology based on research findings.

4. *Comparative analysis of previous policies*

Before looking at how the 2023 plan differs from India's past space policies, it's important to understand what those policies were and what they discussed. The Satellite Communication Policy of 1997 addressed how satellite communications in India are managed.[13]The Remote Sensing Data Policy 2001 outlined how remote sensing data technology may be expanded in India.[14] The National Geospatial Policy, 2016, discussed specific features of GDPSS-related technologies.[15]

As we can see, all past policies were quite confined in terms of their goals and objectives. In contrast, the 2023 policy addresses the bigger picture. It focuses on private stakeholders and emphasizes their engagement in India's space operations. It outlines more extensive ideas for incentivizing and facilitating space operations. Moreover, the 2023 policy underscores India's aspiration to expand the breadth of its foreign collaboration in technological advancement, research, and aerospace exploration. Engagement in international lunar and solar missions is an additional priority. The prior policies, on the other hand, were overly narrow and national in scope; they recognised the importance of international collaboration but provided no clear plans for implementing it. The 2023 strategy outlines a more comprehensive approach to national security in space, including techniques for protecting India's space assets and defense-related satellite applications. Previously implemented policies did not provide a comparably broad foundation for space-based defence applications.

5. *Economic impact of space activities*

Antrix Corporation, the commercial division of ISRO, provides satellite launch services to international clients, resulting in significant revenue generation. Moreover, ISRO's broadcasting assets, including the GSAT series of communication satellites, have substantially enhanced the proliferation of communication services in India. This has boosted the telecommunications sector, hence facilitating economic expansion.

[13] Department of Space, Government of India, *Satellite Communication Policy* 1997.

[14] Department of Space, Government of India, *Remote Sensing Data Policy* 2001.

[15] Department of Science and Technology, Government of India, *National Geospatial Policy* 2016.

Furthermore, the NavIC system, India's regional satellite navigation system, has applications in agriculture, transportation, and disaster management, and it has resulted in significant cost savings in these areas. ISRO's operations have accelerated the growth of space-related research and education, which is a vital initiative. The Indian Institutes of Space Science and Technology is a well-known university that offers studies in space technology and science. In terms of employment, 120,000 individuals in OECD countries[16] and 250000 people in Russia work in the space sector.[17]

The space industry in India employs over 45,000 individuals. The expansion of India's space program has generated employment opportunities both directly within ISRO and indirectly in associated enterprises involved in space technology, manufacturing, and research.[18] Infrastructure Advancement and Technological Progress ISRO's satellite communication capabilities have enabled direct-to-home (DTH) transmission, providing nationwide access to a diverse array of television channels. Rural regions have obtained internet connectivity and agricultural knowledge via programs such as Village Resource Centres and Common Service Centres. Moreover, remote sensing technology has enhanced decision-making in urban planning, forestry, and water resource management.

The space industry has impacted research and development in electronics, materials science, and propulsion technologies, alongside fostering a workforce with specialized skills and university institutions dedicated to space science and technology. Opportunities and Challenges Space technology depends on specialized expertise and advanced innovations; nevertheless, India's constrained investment in research and development presents possible obstacles to sector growth. Consequently, private firms and start-ups struggle to manage elevated expenses, requiring a pivotal role from the government in promoting growth.

[16] OECD, *The Space Economy at a Glance 2007* (OECD Publishing 2007), https://doi.org/10.1787/9789264040847-en.

[17] A. Ionin, *Russia's Space Program in 2006: Some Progress but No Clear Direction*, Moscow Defense Brief (Aug. 27, 2007), https://web.archive.org/web/20070827204307/http://mdb.cast.ru/mdb/2-2007/item1/item3/ (accessed Mar. 20, 2024).

[18] P. Abrar et al., *India's Aerospace Start-ups Eye Rocket Launches and Planetary Missions, Business Standard* (June 26, 2020), https://www.business-standard.com/article/companies/india-s-aerospace-start-ups-eye-rocket-launches-and-planetary-missions-120062600871_1.html (accessed Mar. 20, 2024).

6. *Market opportunities and potential growth areas*

The Indian space sector presents several opportunities for advancement and innovation. Given a demonstrated history of effectively deploying satellites for various nations, there is an increasing need for economical satellite launch services. This not only provides revenue-generating opportunities, but also allows India to increase its footprint in the global commercial launch business.[19] Furthermore, satellite imagery and data are used for a variety of applications, including agriculture.

Space tourism is gaining popularity globally, and India has the opportunity to explore this developing business, maybe through partnerships with international space agencies. The proliferation of space-oriented start-ups in India enhances opportunities for innovation and entrepreneurship. These start-ups are exploring several subjects, such as satellite technology, data analytics, and space-based applications, thereby enhancing the sector's overall dynamism.

This section of the document gives a backdrop for India's 2023 Space Policy. It emphasized the policy's dual goals for the government and the private sector, as well as India's intention to capitalize on its unique space technological capabilities. The chapter also presented a historical review of India's space project growth, acknowledging notable personalities such as Vikram Sarabhai and Homi Bhabha and significant milestones. The article underlined the need for private enterprises to remain competitive and adaptive in the ever-changing space market. It also highlighted the significance of India's 2023 Space Policy, focusing on its ability to encourage space activities and expand human understanding of space.

The paper additionally examined the economic ramifications of India's space initiatives. It pertained to Antrix Corporation's involvement in satellite launch services, ISRO's contributions to broadcasting and navigation, and employment generation within the space sector. The chapter also underscored the significance of space technology in advancing research, education, and technological development. The study ultimately addressed the economic challenges facing India's space program, including substantial investment expenditures, limited research and development funding, and a deficiency of skilled personnel. The analysis examined market possibilities and potential growth sectors within the space industry, including economical satellite launches, remote sensing services, space-oriented start-ups, and the emerging field of space tourism.

[19] R. Sood, *An Indian Space Law: Long Overdue, ORF Online* (Mar. 31, 2020), available at https://www.orfonline.org/research/indian-space-law-long-overdue-54867/.

7. *Commercialisation of outer space*

India's space sector offers numerous prospects for development and innovation. With a proven track record of successfully launching satellites for numerous countries, there is a growing need for low-cost satellite launch services. This not only provides revenue-generating opportunities, but also allows India to increase its footprint in the global commercial launch business. Furthermore, satellite imagery and data are used for a variety of applications, including agriculture.

Space tourism is growing popularity around the world, and India has an opportunity to investigate this emerging market, possibly through collaborations with international space agencies. The growth of space-focused start-ups in India expands the possibilities for innovation and entrepreneurship. These start-ups are experimenting with a variety of topics, including satellite technology, data analytics, and space-based applications, which adds to the sector's general vibrancy.

This section of the document gives backdrop for India's 2023 Space Policy. It emphasised the policy's dual goals for the government and the private sector, as well as India's intention to capitalise on its unique space technological capabilities. The chapter also presented a historical review of India's space project growth, acknowledging notable personalities such as Vikram Sarabhai and Homi Bhabha, as well as significant milestones. The article underlined the need for private enterprises to remain competitive and adaptive in the ever-changing space market. It also highlighted the significance of India's 2023 Space Policy, with a focus on its ability to encourage space activities and expand human understanding of space.

The article also discussed the economic implications of India's space programmes. It referred to Antrix Corporation's role in satellite launch services, ISRO's contributions to broadcasting and navigation, and job creation in the space industry. The chapter also emphasised the importance of space technology in promoting research, education, and technological progress. Finally, the paper discussed the economic obstacles confronting India's space programme, such as high investment costs, restricted R&D funding, and a shortage of experienced people. It also looked into market prospects and possible growth sectors in the space sector, such as low-cost satellite launches, remote sensing services, space-focused start-ups, and the developing profession of space tourism.

The idea of commercial space activity in India is not a new phenomena; it was introduced during the Space 2.0 phase, which is currently focused on helping space entrepreneurs and small and medium-sized businesses to compete in the $300 billion commercial space race.[20] Evidence of commercial space activity may be traced back to 1992, when Antrix Corporation Limited, an Indian government-owned company, was established. The Pragyan Rover, launched on Chandrayaan-2, is one of India's most successful artificial intelligence rovers, proving the power of AI in space missions[21].

Artificial intelligence can improve commercial space activities in India by assisting with project risk assessment, data collection, analysis, mapping, product development, technology capacity building, efficient launch and landing, mission success rates, and commercial remote sensing. A central space law must be passed to ensure the successful application of artificial intelligence in commercial space activities. Such legislation would have to preliminarily specify the areas of commercial space in which private enterprises can contribute and those in which they are prohibited, provide guidelines for jurisdiction over space objects and discoveries, and envisage clear liability principles and a penal structure mechanism. It is undeniable that in the first several decades of the law's operation, it will be impossible to accommodate totally privatised commercial operations, and oversight will be severe in order to promote sustainable and orderly commercial space utilisation.

Given that space activities involve country responsibility, have a significant impact on diplomatic and international relations, and have an impact on the planet itself, it is imperative that the penal mechanism incorporated into an Indian space law not only be closely related to Indian criminal jurisprudence, but also create a right in rem in the form of a special law. Given the variables at stake, the combination of responsibility and penology will need to be strict. One of the distinguishing features of a right in Rem is that, while it is available against the world, it is actually a right that exists in a person, making other parties who owe a co-relative obligation accountable.[22]

---

[20] P. Narayan, *Space 2.0 India: Leapfrogging Indian Space Commerce*, in *Space India 2.0: Commerce, Policy, Security and Governance Perspectives* 1-10 (Mumbai: Mohit Enterprises, 2017).

[21] S. Gupta, *AI Applications in Space Exploration: NASA, Chandrayaan 2 and Others, Springboard Blog* (Dec. 4, 2019), https://in.springboard.com/blog/ai-applications-in-space-exploration-nasa-chandrayaan2-and-others/ (accessed February. 24, 2024).

[22] A. Kocourek, *Rights in Rem, Penn Law: Legal Scholarship Repository* (1920), available at https://scholarship.law.upenn.edu/cgi/viewcontent.cgi?article=7785&context=penn_law_review.

As a result, a special tribunal will be required under a central space law, with the authority to punish violators with suitable fines and imprisonment. Under normal conditions, these tribunals will consider claims brought by aggrieved citizens in India. It goes without saying that sovereign states that choose to launch their space products and programmes through India will seek redress if they face delays induced by private entities. The Indian government can help by offering such assistance. In practice, central space law would have to precisely define the cases resulting in liability while prohibiting excessiveness. This ensures a balance between sovereign nations launching from India and the private sector engaging in commercial space activities. It is worth noting that in the absence of these aspects in a codified space law, commercial space activities would not run smoothly, and the use of artificial intelligence may not produce the greatest results. In other words, a strong and comprehensive central space legislation is required to allow increased expansion in commercial space through the use of artificial intelligence. After completing the first phase of adopting a coherent central space law, public-private partnerships must be incorporated into the terms of such law. Several applicable public-private partnership models, such as Design Build Operate Transfer (DBFOT), Operate Maintain Transfer (OMT), and Build Own Operate Transfer (BOOT), as well as other innovative models that meet the requirements, and a model concession agreement to govern the relationship between the public and private sectors for commercial space, must be formalised. Although the Indian Space Research Organisation and the Indian Government[23] have recently floated various tenders for public-private partnerships (Indian Space Research Organisation Satellite Centre, 2018), the volume of operations will significantly increase following the adoption of a central space law, rendering the current structure insufficient. To increase the development and usage of artificial intelligence in these operations, partnerships with technology-based, robotics, and artificial intelligence development firms will be required to grow. Incentive plans, including as tax and tariff waivers, partial and total land allocation, and government subsidies, have been one of the most successful methods of attracting investment and partnership in any area in India. Attracting investors and constructive public-private partnerships between artificial intelligence tech- companies and the ISRO can lead to the positive development of enhancement in the manufacture and innovation of space products, which will significantly boost collaboration

[23] Government of India, Department of Space, *Tender Document for Setting Up of IT Infrastructure for North Eastern Spatial Data Repository (NeSDR)*, North Eastern Space Applications Centre (2017) (Reference No. NESAC/877/2017).

of Antrix Corporation with the National Remote Sensing Centre[24] to do commercial remote sensing in India. The information gathered has greatly aided telecommunications, internet services, geographical positioning, crop surveillance, disaster management, and other commercial activities[25] India has established a partnership with countries including the US, Germany, Russia, China, UAE, Australia, Kazakhstan, Algeria, Myanmar, Thailand, and Saudi Arabia for commercial remote sensing. These countries now have direct access to Indian satellites.[26] The ISRO has already used artificial neural networks in mission support systems, data gathering, processing, transmission, mapping, and management, as well as monitoring the structural health of space goods.[27] Laws and policies must allow for greater private sector involvement to enhance commercial usage of remote sensing data further. IBM already uses remote sensing data, artificial intelligence, and blockchain to produce precision agriculture in India.[28] As a result, private sector involvement in commercial remote sensing data management can also benefit other areas.

8. *Space debris*

Space debris has long posed a threat to orbital and suborbital spacecraft. Furthermore, the possibility of such space debris entering the Earth's atmosphere is constantly present. Artificial intelligence has previously been used for catastrophic dispersion analysis and space debris tracking using software tools like as PHILOS-SOPHIA, which features a graphical user interface and hydrocode numerical simulations. Identifying space debris in

[24] National Remote Sensing Centre, *Remote Sensing Applications, National Remote Sensing Centre* (2015), available at https://www.nrsc.gov.in/Aboutus/NRSC_RSA/page1.html.

[25] Press Information Bureau, *Artificial Intelligence*, Press Information Bureau, Government of India, Ministry of Defence (Jan. 2, 2019), available at https://pib.gov.in/newsite/PrintRelease.aspx?relid=187044.

[26] S. K. R. Murthi, *A Review of India's Commercial Space Efforts*, Observer Research Foundation (Mar. 1, 2017), available at https://www.orfonline.org/research/a-review-of-indias-commercial-space-efforts/

[27] V. M. R. M. Manickam, *Research Study on Applications of Artificial Neural Networks and E-Learning Personalization,* 8 *Int'l J. Civ. Eng. & Tech*. 1422-1432 (2017).

[28] B. Pereira, *How IBM is Using Remote Sensing Data, AI and Blockchain for Precision Agriculture, Digital Creed* (Feb. 25, 2019), available at https://www.digitalcreed.in/ibm-precision-agriculture/.

advance can help map the course for launched space vehicles and prevent extraordinary loss and damage during space operations. In March 2019, India destroyed its test satellite with a ground-based missile, resulting in a huge increase in space debris.[29] Even otherwise, the formation of space debris was an unavoidable inevitability. Using robotics and artificial intelligence in space

Debris cleanup is not a novel concept in today's globe. The European Space Agency plans to launch Chaser, the world's first space debris cleanup robot, as part of its Clear Space Mission-1.[30] India presently has no plans for developing space debris removal robots. It is critical that India encourages the development of such artificial intelligence and robotics-based technologies involved in space debris cleanup in order to boost and extend India's commercial space activities. As previously said, sovereign governments are responsible and liable for their space products, including space debris. This is another significant reason why India must push the development of artificial intelligence solutions for space debris tracking, management, and cleanup.

The role of artificial intelligence in enhancing the defence sector has been enormous. The relationship between space activities and the defence sector is extremely old. This collaboration resulted in improvements to ballistic missile guidance systems, drone control, intelligence gathering, and surveillance. The Indian Ministry of Defence has already begun the process of investing in artificial intelligence to help enhance the Indian defence sector. A multi-stakeholder Task Force on Strategic Implementation of Artificial Intelligence for National Security and Defence has been constituted, with the Indian Space Research Organisation among its members. Although conventional instruments such as the "Partial Nuclear Test Ban Treaty of 1963," the "Outer Space Treaty of 1967", and the "Moon Agreement of 1984" currently require the demilitarisation of space and prohibit the development, storage, or testing of nuclear or other weapons of mass destruction,[31] the use of military or paramilitary forces

[29] L. Grush, *More than 50 Pieces of Debris Remain in Space After India Destroyed Its Own Satellite in March*, *The Verge* (Aug. 8, 2019), available at https://www.theverge.com/2019/8/8/20754816/india-asat-test-mission-shakti-space-debris-tracking-air-force.

[30] Business Insider, *A Bot to Clean Up Space Debris, One Sat at a Time*, *The Times of India* (Dec. 12, 2019), available at https://timesofindia.indiatimes.com/home/science/a-bot-to-clean-up-space-debris-one-sat-at-a-time/articleshow/72484356.cms.

[31] D. G. L. Matignon, *The Legality of Military Activities in Space and Space Law*, *Space Legal Issues* (Jan. 24, 2019), available at https://www.spacelegalissues.com/space-law-the-legality-of-military-activities-in-outer-space/.

to protect State assets in space may not be far off. Many governments are defying the nomenclature of these conventional equipment since it is ambiguous, and space militarisation has continued. The United Nations has expressed concern over this. As a result, the most secure approach would be to restrict artificial intelligence in space to solely government activities to boost the defence industry. Only a binding instrument in international law can have an impact on domestic law and policymaking to prevent space militarization. Currently, a legal framework for space tourism and asteroid mining, which are long-term aims of commercial space operations, is highly favorable, and having such a mechanism in place could prove to be quite helpful. This is because the United States of America and Luxembourg have already passed legislation authorizing asteroid mining,[32] And such operations may not be so farfetched.[33]

It is worth noting that artificial intelligence is also utilized to improve simulation-based astronaut training, risk assessment, and analysis, which can increase the mission success rate of the targeted commercial space activities. Software based on artificial intelligence algorithms, such as the "Space Mission Architecture and Risk Analysis Tool (SMART)", is already used for risk analysis, assessment, mission success, and results. However, the National Aeronautics and Space Administration (NASA) uses this for space missions. India uses the Technology Risk Design/ Dependency Structure Matrix (TR-DSM) for risk assessment and mission planning. However, this method appears to have problems in recognising and evaluating numerous parameters.[34] The Visual Environment for Remote Virtual Exploration (VERVE) is one of the simulation systems used to train NASA astronauts.[35] Astronauts for India's forthcoming Gaganyaan Mission have begun training in Russia.[36] This will be India's first manned mission. The reason Indian astronauts have to be flown to foreign countries for space mission training

[32] D. Porras, *Astro-Propriation: Investment Protections from Space Mining Operations,* in M. Singh (Ed.), *Space India 2.0: Commerce, Policy, Security and Governance Perspectives* 1-10 (Mohit Enterprises 2017).

[33] D. Dickson, *What India's Anti-Satellite Test Means for Space Debris, Sky and Telescope* (2019).

[34] B. McLaughlin, *Automated DSM Analysis*, ENSE623 (2007), available at https://env.umd.edu/projects/07/dsm-presentation.pdf.

[35] National Aeronautics and Space Administration (NASA), *NASA Open-Source Software Projects* (2020), available at https://code.nasa.gov.

[36] Spacewatch Asia Pacific, *Indian Astronaut Candidates Start Training in Russia*, Spacewatch (2020), available at https://spacewatch.global/2020/02/indian-astronaut-candidates-start-training-in-russia/.

is a lack of suitable training technologies in India. Legislation and policy must be reconsidered to meet the objectives of commercial space activity. This is because the increase in such commercial activities in space will eventually result in the emergence of new professions and an increase in space travelers who are not primarily astronauts. Artificial intelligence will play an increasingly important role as more virtual and augmented reality-based simulations are utilised to rigorously train such non-astronaut space passengers. Under such conditions, if technology for training astronauts and non-astronaut space travellers is not available in India, it will become extremely expensive and unfeasible, affecting the volume and quality of commercial and non-commercial space operations.

As a result, it is common knowledge that developing competence in artificial intelligence technology is critical to making progress in these operations. Bilateral accords emphasising the import of artificial intelligence technologies for commercial space activities can be beneficial for capacity growth. However, in order to avoid extremely high reliance rates in the next decades, parallel indigenous growth must be supported and catered for through the Make in India Initiative and the involvement of the private sector. Another important point that a central space law should emphasise is the distinction between regulations for autonomous and human operations. A central space law must provide a slew of delegated legislation, including processes for registration, mission oversight, and licensing.

Establishing jurisdiction and control over launched space products and objects has long been a challenge in space law. Currently, the 1967 Outer Space Treaty states that the sovereign State from which a space object is launched will have authority and control over such space object.[37] A central space law can also handle this. Even though the private sector will be heavily involved, it is critical that the State maintains jurisdiction and control over all space objects and goods. Given that sovereign nations are and will continue to be heavily involved in commercial space activities in the next decades, the state will need to constantly monitor and hold these activities accountable. However, this does not mean that the government should own all space products and objects. Ownership entails a few essential rights, including the right to use the subject matter of ownership, the right to prohibit others from using the subject matter of ownership, and the right to dispose or destroy the subject matter of ownership.[38]

[37] S. Marchisio, *National Jurisdiction for Regulating Space Activities of Governmental and Non-Governmental Entities*, United Nations/Thailand Workshop on Space Law (2010), available at https://www.unoosa.org/pdf/pres/2010/SLW2010/02-01.pdf.

[38] P. Saxena, *Property Law* (3rd ed., Vol. 1) (LexisNexis Butterworths Wadhwa Nagpur 2017).

However, this is not an absolute right and is subject to limitations. Thus, in order to maximize the results of commercial space while also ensuring accountability, once a space product or space object is launched, the State will have jurisdiction and control over it. When a space product or object is used in a commercial space activity, the exclusive right to dispose of or destroy it is likewise suspended. At the same time, the restrictions of the Government's privilege must be clearly defined in the central space law, or it may result in an increase in arbitrary and whimsical official activities. In terms of space objects discovered in space, full ownership for private entities that discover space objects will not be feasible for the first few decades and must be jointly owned by the private entity and the State with the authority to exercise jurisdiction over such private entity. Furthermore, to prevent evident absurdity, a list of space objects that will not result in a claim of ownership upon finding must be specifically established by legislation. India has been a hub for commercial space product launches. Currently, Antrix Corporation is engaging in commercial space launches. The number of foreign satellites launched from India is two in 1999, two in 2001, three in 2007, eight in 2008, six in 2009, three in 2010, two in 2011, two in 2012, six in 2013, five in 2014, sixteen in 2015, twenty-one in 2016, and one hundred and thirty-three in 2017. By 2019, India had commercially launched a total of 319 foreign satellites, resulting in a revenue of INR 1,245 crores from launching foreign satellites. The expansion of commercial space operations in India would also allow private businesses to provide commercial launch services over time. Initially, the private sector may be permitted to offer construction and support services for commercial launches. As a result, to avoid incoherent construction and development that has an impact on Master Plans for urban and rural development, this component must be effectively managed through delegated legislation. If the commercial space sector is prospering in the absence of a space law and widespread use of artificial intelligence, it is reasonable to assume that implementing these components will only contribute to the sector's improvement. Indian space missions are already well-known for being cost-effective, and the country is regarded as one of the best at launching nano and small satellites. However, the central space law will need to address specific issues in order to ensure that all commercial space activities are both cost-effective and environmentally friendly. Because space legislation is not yet concretely legislated in India, its formulation may require producers to research, develop, and use clean and sustainable technology to build space products at lower costs. Clean technology approaches that can be legislated as "basic standards" for Indian-based space products include the use of Space Based Solar Power (SBSP), reusable space vehicles, improved payload management, efficient Power Management and Distribution (PMAD), and energy storage systems.

Furthermore, a space regulatory wing under the Indian Space Research Organisation will need to be developed to control not just the private sector in India, but also exports of Indian-made space products to other countries in the Global South. Furthermore, the national agency can be tasked with providing training to other Global South nations as well as developing standards for Indian cooperation with other countries to launch their products into space. In reality, the Indian Space Research Organisation is currently preparing to teach 45 countries, including Egypt, Mexico, Chile, Indonesia, Malaysia, Oman, Myanmar, and others, to build nanosatellites under the Unispace Nano-Satellite Assembly and Training (UNNATI) program.[39]

9. *India's outer space regime*

The Indian government tightly regulates, monitors, and finances the space market in India, which is under the direct jurisdiction of the Prime Minister's Office. The stringent regulations imposed on India's space industry have impeded its growth. Although the ISRO has achieved notable progress in space technology, India still falls behind its rivals due to insufficient participation from the private sector in the space industry. Nations such as the United States, Russia, China, and France have successfully implemented the privatisation of their space industries, integrating both public and private entities, which has led to significant and rapid growth. This is due to a strong legal framework that regulates space operations in these nations. As an example, the U.S. Commercial Space Launch Competitiveness Act of 2015 grants permission to individuals who are citizens of the United States to participate in the business-related investigation and utilisation of resources in outer space. This rule, along with others, has empowered businesses like Elon Musk's Space X and Jeff Bezos' Blue Origin to establish dominance in the field of space technology.

[39] H. Siddiqui, *Rising Global Stature of ISRO: 45 Countries to be Trained in Making Nano-Satellites, The Financial Express* (Jan. 21, 2019), available at https://www.financialexpress.com/lifestyle/science/rising-global-stature-of-isro-45-countries-to-be-trained-in-making-nano-satellites/1450693/.

Nevertheless, the Indian space business is currently undergoing a shift from a regulated industry to a liberalised one.

The formation of Antrix Corporation, the commercial subsidiary of ISRO, along with the successful commercial deployment of 104 foreign satellites, serves as evidence that the country is progressing in the correct direction. India is embarking on a phase of privatisation and commercialization of space operations. The company is leveraging its exceptional expertise to manufacture satellites and offer launch services utilising ISRO's domestically developed and validated workhorse, the Polar Satellite Launching Vehicle. ISRO Antrix is striving to penetrate the navigation industry through its GAGAN effort, currently dominated by Google Maps. Despite being a relatively new player in this sector, India exhibits substantial potential for expansion. Nevertheless, as HD services and 5G become increasingly prevalent, ISRO/Antrix would be compelled to depend on leasing foreign transponders until India's private sector takes over. Moreover, the space industry has experienced significant progress in artificial intelligence and big data analytics, leading to the emergence of a wide range of new space operations. This has propelled the space sector towards a more business and service-oriented approach, focusing on the implementation of end-to-end efficiency concepts. India has witnessed the rise of approximately twenty-four new space enterprises in various sectors like crop insurance, infrastructure monitoring, watershed development, flood monitoring and forecasting, forest fires, and asset mapping. Nevertheless, these initiatives have encountered difficulties in gaining momentum as a result of convoluted regulations and an outdated model of vendor-supplier relationships.

Establishing a suitable legislative framework is crucial for effectively governing these activities and promoting the overall expansion of the space sector. The draft Space Activities Bill, which was introduced in 2017, has now lapsed, enabling the legislature to shift its attention to a new bill that will be well-received by both large enterprises and startups in the business sector. India's efforts to enhance domestic regulations and let private enterprises to participate in the space sector have shown no advancement in recent times.

As per the transfer policy, the task of satellite manufacture was delegated to a private-sector enterprise for the first time. This action was undertaken to advance the objectives of the 'Make in India' initiative. Additionally, ISRO entered into a contractual agreement with an Indian start-up. The international system encompasses a variety of space laws that govern transactions and conflicts between governments in the space industry. The utilisation of outer space for peaceful intentions is the fundamental basis of the international legal framework.

10. *The current international legal standing*

The framework provides a broad declaration of concept but does not deal with the complex legal issues related to specific activities. After the launch of the first satellite, Sputnik, into space in 1957, the United Nations created the Committee on the Peaceful Uses of Outer Space (COPUOUS), consisting of two sub-committees: a scientific and technical committee and a legal committee. The UN Office of Outer Space Affairs functions as the administrative body for the Committee on the Peaceful Uses of Outer Space (COPUOS), responsible for monitoring and recording space launches, among other tasks. COPUOUS has played a crucial role in the development of five significant international space treaties: the Outer Space Treaty (1967), the Rescue Agreement (1968), the Liability Convention (1972), the Registration Convention (1974), and the Moon Agreement (1979).

The Outer Space Treaty serves as the fundamental basis of international space law, having been ratified by 109 countries and signed by 23. The treaty prevents governments from deploying weapons of mass destruction in space or on celestial bodies. However, it does not restrict the deployment of conventional weapons in space, such as anti-satellite weapon systems. Additionally, it restricts the use of the moon for non-aggressive intentions. The Outer Space Treaty also prevents states from asserting territorial rights over the moon and other celestial bodies, while upholding the boundaries established by the treaty. If a space object, component, or debris from a launching state causes harm to another state party or its own individuals or entities on Earth, in the air, or in outer space. According to Article V of the Outer Space Treaty, the Rescue Agreement of 1968 requires signatory states to offer maximum assistance in retrieving space objects and astronauts that may land within their territory. The expenses incurred in this process are to be covered by the state responsible for launching them. The 1972 Liability Convention mandates that the state responsible for launching is obligated to provide compensation for any harm caused by its space components, debris on the Earth's surface, and aircraft. It holds the state responsible for the harm produced by its issues related to space. When two or more states work together, they share equal and individual responsibility. The Registration Convention of 1974 mandates that states provide details regarding the orbital characteristics and intended function of every space object they launch. States that conduct space launches are required to maintain a record of each launch, including both items and persons. The Moon Agreement of 1979 emphasises that celestial bodies should exclusively be utilised for peaceful endeavours and that their environment must not be modified. The statement affirms that the moon and other celestial bodies belong to all of humanity and should not be claimed by any government.

India is a signatory to the Outer Space Treaty, which is the main body of international law governing outer space. This is specified in Article 51 of the Indian Constitution.

India has actively engaged and offered assistance to various international forums, such as the United Nations Committee on Peaceful Uses of Outer Space, the International Council of Scientific Unions, and the International Astronautical Federation, in establishing global space and legal policy. However, India has signed all of these agreements, but it does not have complete legislation on matters connected to space. The space sector in India has been under government jurisdiction. Therefore, there is no need for extensive space legislation in India. As India progresses towards privatisation, the need for a specialised space law becomes crucial. India is adversely affected by loopholes in the framework of International Space Law. India's lack of domestic space regulations has made it vulnerable to international treaties' faults.[40] In 2017, the nation became embroiled in a global conflict with Japan due to the descent of space debris from an ISRO satellite onto a Japanese fishing town.[41]

India, as a party to the Convention on International Liability for Damage Caused by Space Objects (1972), bears full responsibility and is obligated to provide compensation for any harm caused by its space objects to the Earth's surface or aircraft, as well as for any damage resulting from defects in space. Japan requested that India provide compensation for the harm caused by its space debris. Due to the absence of a comprehensive national space law and policy to safeguard its interests and establish liability limitations in case of damage, India faced difficulties in determining the

[40] M. Pracha, *Workshop on Capacity Building in Space Law* (2002).

[41] R. Sood, *An Indian Space Law: Long Overdue, ORF Online* (Mar. 31, 2020), available at https://www.orfonline.org/research/indian-space-law-long-overdue-54867/.

extent of damages owed and protecting its interests. This loophole was exploited by Japan, resulting in the extraction of funds from India that surpassed the actual amount of damage. Consequently, India suffered a significant financial loss. If there had been complete legislation in place, the described loss may have been reduced.

11. *Conclusion*

India is becoming as a prominent participant in the global commercial space industry. The government is swiftly expanding its space industry. In order to meet its increasing requirements, India need comprehensive space legislation. Failure to enact such legislation may lead to financial losses and a loss of skilled individuals. In light of the growing demand in the space industry, it is imperative to address crucial issues such as control, safety, authorization, agreements, and conflict resolution techniques for space-related operations. Legislation pertaining to contracts, property transfers, stamp duty, registration, and licencing of intellectual property must be revised to encompass space-related issues within the scope of national authority.

The regulatory framework for space activities in India is determined by a confluence of government regulations, procedures, and directives, with the most prominent ones being the policy framework for satellite communications in India (SATCOM), the Remote Sensing Data strategy of 2011,609, and ISRO's technology transfer strategy. Due to these improvements, private satellite system participation is now allowed. However, there is no legal provision to safeguard the operator or the government in case of liability arising from damages. In addition, India has an extensive national policy on remote sensing. There is an absence of a nationwide legislation. The Remote Sensing Data Policy of 2001 encompassed regulations for the procurement, dissemination, and safeguarding of data for the purpose of national security.[42] In 2001, amendments were made to remove limits on the supply of satellite data up to the resolution.

The 2011 policy also created the National Remote Sensing Centre, which acts as the main governing body responsible for obtaining and distributing satellite remote sensing data in India for the sake of development.

[42] M. Pracha, *Workshop on Capacity Building in Space Law* (2002).

Nevertheless, the central government tightly regulates this process and retains the authority to enforce control in situations involving national security, international responsibilities, or foreign policies. This policy did not adapt and hence its effectiveness was limited. As technology progresses, the need and desire for data with increasing levels of detail increases. This requires the establishment of a thorough space strategy that can effectively coordinate satellite data on both a national and international level.

While the existing absence of explicit laws in space may be sufficient for now, it is necessary to establish a precise statute. The current approach must be reevaluated, namely in consideration of Article 51 of the Constitution. The national space legislation should be equitable in line with industry norms and have the capacity to address both present and future advancements. The document should specifically cover legal issues related to launch services, satellite telecommunications, data processing and distribution, satellite navigation systems, the intellectual property rights (IPR) regime, and technology transfer. Additionally, it should provide guidelines for financing and ensuring safety.[43]

Global collaboration. Implementing a comprehensive national policy will enable ISRO to allocate its workforce to research and development fully, hence creating fresh prospects for the country in the field of outer space. In 2017, the administration sought to establish an all-encompassing nationwide policy. The proposal encompasses several aspects such as insurance, licencing, liability, responsibility, dispute settlement, and environmental protection. Global collaboration. Implementing a comprehensive national policy will enable ISRO to allocate its whole workforce to research and development, hence creating new prospects for the country in the field of outer space.

In 2017, the administration sought to establish an all-encompassing national policy. The Space Activities Bill was introduced and discussed in Parliament. The objective of this initiative is to facilitate, endorse, and oversee space activities in India by granting permission for commercial and non-governmental entities to operate in the space industry under the guidance of the Indian government's Department of Space. Upon initial examination, the bill seemed to be extensive and inclusive, resembling typical initial legislative efforts to address technical advancements and their societal implications. The bill modifies the pre-existing model law solution provided by the International Law Association to suit the specific

[43] S. K. Yadav, *International Space Law Applicability in Indian Perspective*, 6 *Int'l J. Sci. & Res*. 14 (2013).

requirements of India. Its jurisdiction is restricted for law enforcement.

Partially, it recognises the importance of the private sector in utilising space for advancing human communications and scientific pursuits. However, it also grants significant authority to the government in regulating access to space. India possesses very advanced space technology that has demonstrated significant potential. Nevertheless, in order for India to achieve its goal of being a 10% contributor to the global space economy by 2030, it is imperative that the country undergoes a significant advancement in technological development, embraces new organisational models, and engages in collaborative efforts. India has the potential to play a pivotal role in creating a conducive legislative framework for space exploration, effectively managing the interests of both the public and commercial sectors, and adjusting to evolving global circumstances.

ISRO is in a favourable position to concentrate on this task. The organisation should streamline its operations and focus on its core competencies given its limited resources. In order to prevent any potential conflicts of interest, it may be necessary to sever the umbilical connection with Antrix.[44] And assign the responsibility for the military aspects of space technologies to the Ministry of Defence. In addition, ISRO can take advantage of the thriving startup culture in India by implementing the incubator method, which has been successfully pioneered by both NASA and the European Space Agency.[45] It is imperative for ISRO to persist in the development of Tier 1 vendors and original equipment manufacturers. The commercialization of PSLV launch technology and the introduction of the new SSLV for launching Indian and multinational satellites into low earth orbit represent a commendable advancement.

A conducive policy framework is crucial for overseeing these activities while also promoting the overall expansion of the space industry. It is crucial to exercise caution in order to prevent excessive government regulation in the sector and to properly handle concerns related to intellectual property rights. The new space framework should have sufficient flexibility to promote foreign direct investment, thereby establishing India as a centre for global space operations. The expiration of the Space Activities measure 2017 has given the government the opportunity to concentrate on a new measure that would address the previously identified difficulties.

[44] Antrix Corporation, *Launch Services, Antrix Corporation* (2019), available at http://www.antrix.co.in/business/launch-services.

[45] K. Schultz, *NASA Says Debris from India's Anti-Satellite Test Puts Space Station at Risk, The New York Times* (Apr. 4, 2019), available at https://www.nytimes.com/2019/04/04/science/nasa-india-anti-satellite-test.html.

Maria Rhimbassen

"Breton" Woods: Marketization of the European Space Sector

Summary: 1. Introduction – 2. Very Catchy Pillars – 3. Catch Me if You Can: Blue Space – 4. Conclusion.

1. *Introduction*

The recent announcement of the disclosure of a new European Space Law (EUSL) by the European Commission (EC) has taken much of the space community by surprise[1]. Even more surprising is the fact that this legislative process is not only far from transparent, but constantly being delayed[2], causing thus frustration[3]. Not helping is the fact that the person pushing for this legislation was the former European Commissioner for Internal Market, Thierry Breton, representing France. In part, political tensions explain most of the delay[4] (e.g French vs German interests, being

[1] Evroux, C., EU space law, In "A Europe Fit for the Digital Age", European Parliament, Legislative Train Schedule, 20/05/2024, available at: https://www.europarl.europa.eu/legislative-train/theme-a-europe-fit-for-the-digital-age/file-eu-space-law#:~:text=The%20proposed%20EU%20space%20law,consistent%20and%20EU%2Dwide%20approach, consulted on June 10th, 2024.

[2] Fauroux, M., L''Événement «Space Law»: l'industrie prise de court par le report de Thierry Breton, La Lettre, 15/04/2024, availble at: https://www.lalettre.fr/fr/entreprises_defense-et-aeronautique/2024/04/15/space-law--l-industrie-prise-de-court-par-le-report-de-thierry-breton,110214727-eve, consulted on June 10th, 2024.

[3] Stefoudi, D., EU Space Law – Three reasons against, three reasons in favour, EJIL:Talk!
Blog of the European Journal of International Law, 29/04//2024, available at: https://www.ejiltalk.org/eu-space-law-three-reasons-against-three-reasons-in-favour/, consulted on June 10th, 2024.

[4] Hartmann, T., Thierry Breton says European Space Law might be presented after the summer, Euractiv, 09/04/2024, availbale at: https://www.euractiv.com/section/industrial-strategy/news/thierry-breton-says-european-space-law-might-be-presented-after-the-summer/, consulted on June 10th, 2024.

the classical scenario), but these tensions have also competitive roots (e.g. French vs German industry) and as a result, laudable alliances[5] and consortia end up failing, as illustrated by the fresh failure of the future European IRIS² secure connectivity constellation[6], yet another project backed by Commissioner Breton, who himself has a historical baggage of mitigated business credentials[7]. Even more problematic is the fact that Europe currently lacks access to space autonomy and must rely on external competition (e.g. SpaceX) to launch basically anything, including sensitive payloads[8] (i.e. Galileo), due to Ariane 6 failures and delay.

At this point, Europe faces a credibility crisis[9] with regards to its commitment to the space sector and the ability to maintain sovereignty. Can Europe pull its act together instead of relying on foreign actors that it simultaneously condemns and chases out[10] (i.e. Iris² vs Starlink; Arianespace vs SpaceX[11], etc.)? In light of these facts, knowing that the

[5] Sheehan, G., Entringer, K., Un consortium européen s'allie pour le projet de satellites Iris2, Usine Nouvelle/Reuters, 02/05/2023, available at: https://www.usinenouvelle.com/article/un-consortium-europeen-s-allie-pour-le-projet-de-satellites-iris2.N2128841, consulted on June 10th, 2024.

[6] Rovan, A., Avril, P., L'Allemagne s'oppose à Iris2, le «Starlink européen» jugé trop favorable à la France, le Figaro, 02/05/2024, available at: https://www.lefigaro.fr/conjoncture/l-allemagne-s-oppose-a-iris2-le-starlink-europeen-juge-trop-favorable-a-la-france-20240502, consulted on June 10th, 2024.

[7] Herrerro, O., et al., Européennes: les déboires d'Atos parasitent les ambitions de Thierry Breton, Politico, 09/11/2023, available at: https://www.politico.eu/article/europeennes-les-deboires-datos-parasitent-les-ambitions-de-thierry-breton/, consulted on June 10th, 2024.

[8] Pugnet, A., EU formally approves extraordinary, one time satellite launch from US territory, Euractiv, 20/03//2024, availbale at: https://www.euractiv.com/section/defence-and-security/news/eu-formally-approves-extraordinary-one-time-satellite-launch-from-us-territory/, consulted on June10th, 2024.

[9] Meddah, H., Le patron du Gifas décortique l'enchaînement infernal qui a précipité l'Europe spatiale dans une crise inédite, Usine Nouvelle, 05/01/2023, available at: https://www.usinenouvelle.com/article/quand-le-patron-du-gifas-explique-l-enchainement-infernal-qui-a-pousse-l-europe-spatiale-dans-une-crise-inedite.N2082861, consulted on June10th, 2024.

[10] Lamigeon, V., Spatial: Prends garde Starlink, voici Iris2, la future constellation de connectivité européenne, Challenges, 17/11/2022., available at https://www.challenges.fr/entreprise/prends-garde-starlink-voici-iris2-la-future-constellation-de-connectivite-europeenne_835861, consulted on June 10th, 2024.

[11] Lancrenon, T., Subventions: SpaceX attaque Arianespace, Portail de l'IE, 21/02/2019, available at: https://www.portail-ie.fr/univers/enjeux-de-puissances-et-geoeconomie/2019/subventions-spacex-attaque-arianespace/, consulted on June 10th, 2024.

future EUSL will officialize the paradigm shift of the space "sector" to "market", the question whether Europe is able to manage such an internal market arises due to the observed struggle. Is marketization really the key solution?

2. *Very Catchy Pillars*

The discourse pertaining to the three pillars, mentioned previously rather resonates with a marketing discourse more than anything else, reflecting much of the history of its main advocate, Breton, illustrating thus the result of "revolving doors"[12] and the trivialization of such marketing jargon that replaces legalese. Marketization means:

> "Marketisation or marketization is a restructuring process that enables state enterprises to operate as market-oriented firms by changing the legal environment in which they operate"[13].

Will then EUSL be just another legal instrument at the service of such a market? What role will the public sector assume (market "creator" or "fixer")? Why is most of the European space community kept in the dark so far over the drafting of this text? Does that help build a sense of belonging or rather does it increase fragmentation and annoyance/resentment from uninvited "guests"? Does it do anything at all? The announced pillars already foreshadow a "much ado about nothing" substance since they refer to the all-purpose "safe, resilient and sustainable" sauce.

2.1. *The Catch-Up Sauce Applied Over and Over*

It seems that Europe is positioning itself to wage an economic warfare in the space sector since the EUSL literally acknowledges the transformation

[12] European Ombudsman, How the European Commission manages 'revolving doors' moves of its staff members, CASE OI/1/2021/KR - OPENED ON Wednesday | 03 February 2021 - DECISION ON Monday | 16 May 2022 - INSTITUTION CONCERNED European Commission (No further inquiries justified) - COUNTRY France, available at: https://www.ombudsman.europa.eu/fr/case/en/58428, consulted on June 10th, 2024.

[13] Van der Hoeven, Sziráczki, G., Lessons from Privatization. (1997). International Labour Organization. ISBN 92-2-109452-9 p. 101.

of the space "sector" into a space "market" ("Towards a single market for space and more robust systems")[14], aimed at reducing dependencies:

> (...) du point de vue industriel, c'est plutôt la **guerre économique**, car il y a une véritable course ». La raison est assez simple : comme pour toutes les technologies sans fil, le spectre n'est pas infini et les fréquences sont donc un bien rare et extrêmement précieux.[15] (emphasis added)

But does Europe have what it takes? The main foreign competitor, SpaceX, has a decade of lawfare and antitrust experience and expertise (e.g. SpaceX *v* ULA saga[16]; SpaceX *v* NASA/Blue Origin series[17], etc.) to the point that it has become one of its main business strategy/tactic/activity in progressively gaining new market sectors.

European space is a soon-to-be single "market" in the space ecosystem and therefore another legally attackable target, just as previous attempts signaled what's ahead (i.e. SpaceX v Arianespace[18]). The irony however is that if Europe goes down the space path, blindfolded, without a clear vision/mission, the resulting lack of technology and capability makes all this lawfare in the works pretty irrelevant. Arianespace might have ended up winning the first round, but Europe is now on its knees begging the US to launch their (sensitive) payloads, which is, let's face it: nothing short of humiliating.

Therefore, in this context, not only does Europe face a credibility crisis, but an identity one. Europeans must ask the question: "What are we doing in space? What is our purpose?". Does Europe persevere to remain in the

---

[14] Towards a single market for space and more robust systems, European Commission, 23/01/2024, available at: https://defence-industry-space.ec.europa.eu/towards-single-market-space-and-more-robust-systems-2024-01-23_en, consulted on June 10th, 2024.

[15] Le Boulc'h, D., in Gavois, S., Constellations de satellites: « il n'y a que six places » dans la course mondiale, NEXT, 20/03/2023, available at: https://next.ink/1233/constellations-satellites-il-ny-a-que-six-places-dans-course-mondiale/, consulted on June 10th.

[16] Erwin, S., SpaceX presses on with legal fight against U.S. Air Force over rocket contracts, Space News, 22/01/2020, available at: https://spacenews.com/spacex-presses-on-with-legal-fight-against-u-s-air-force-over-rocket-contracts/, consulted on June 10th.

[17] Sheetz, M., Bezos' Blue Origin loses NASA lawsuit over SpaceX $2.9 billion lunar lander contract
CNBC, 04/11/2021, available at: https://www.cnbc.com/2021/11/04/bezos-blue-origin-loses-lawsuit-against-nasa-over-spacex-lunar-lander.html, consulted on June 10th, 2024.

[18] Bauer, A., Exclusif: SpaceX accuse Arianespace de concurrence déloyale, Les Echos, 21/02/2019, availble at: https://www.lesechos.fr/industrie-services/air-defense/exclusif-spacex-accuse-arianespace-de-concurrence-deloyale-992893, consulted on June 10th, 2024.

space race just to be part of the game with rules and goals set by others according to their own values/morals? Do Europeans genuinely care about building either settlements on Mars or outposts on the Moon at this stage? Or does Europe just struggle to mimic the bigger bear? Or is the reality much more down to Earth in fact and space is more of a security and defense domain, a connectivity enabler? If so, probably the space sector/market must be debunked once and for all and integrated to all other daily aspects of our technological society at large. For instance, Canada has incorporated a space clause into its very own Criminal Code[19], which thus gained new (extra) territory, "spacializing"[20] thus Canadian law from the ground up, while "normalizing" life in space. What would a similar "bottom-up" approach instead of a "top-down" approach do in Europe? For the European market?

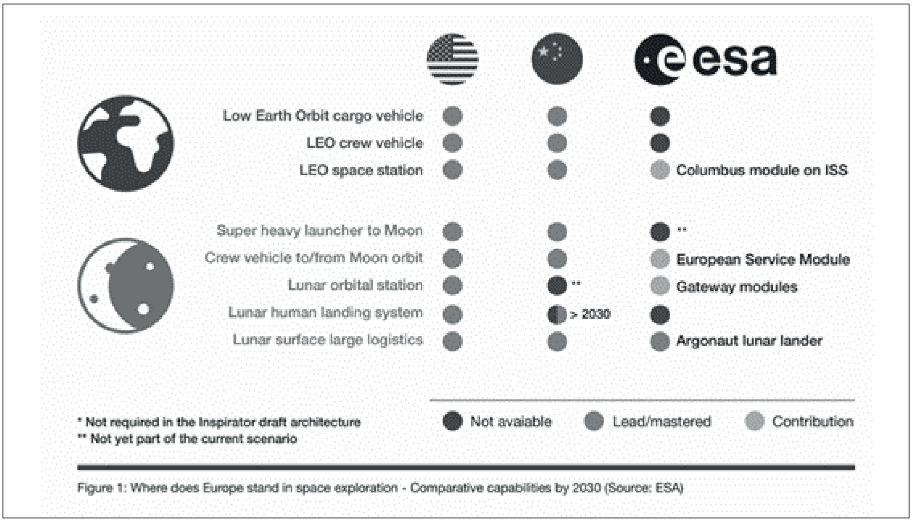

Figure 1: Comparative Space Operations Landscape[21]

[19] Government of Canada, Criminal Code of Canada,,Criminal Code (R.S.C., 1985, c. C-46), Section 7 (2.3) ,last amended on 14/01/2024, available at: https://laws-lois.justice.gc.ca/eng/acts/C-46/section-7.html, consulted on June 10th, 2024.

[20] Rhimbassen, M., Canadian Space Law: Pioneers Lost Into The Polar Night, Comparitive Visions in Space Space Law, Conference Communication, Roma Tre University, Friday 9th, 2024, available at: https://www.youtube.com/watch?v=Rtgi6g8sbxg, consulted on June 10th, 2024.

[21] Mazzucato, M., et al., Revolution Space: Europe's Mission for Space Exploration, Report of the High-Level Advisory Group on Human and Robotic Space Exploration for Europe, March 2023, available at: https://esamultimedia.esa.int/docs/corporate/h-

Mazzucato best explains this:

> To reinforce this message, space must expand its cooperation strategy and reach stakeholders beyond space and technical fields. "More than a space programme" means just this, **we have to actively build a bridge between sectors and generations so that as many institutions and people as possible can see and benefit from the value of space and support its enhancement.**[22] (emphasis added)

Therefore, Europe must set its sights on just the right mission[23] and find the right fit. The cost of investing is inferior to doing nothing:

> "**The cost of inaction would far outweigh the necessary investment to establish Europe as a strong and independent space actor.** For Europe to become a **transformative player able to make a difference, truly grand goals and narratives are required,** identifying, and exploiting the full strategic dimension of space and space exploration. Europe needs to recognise that this entails prompt action to catch-up and **leapfrog the competition, and shape the future in line with Europe's values**."

Mazzucato further adds in her report that inspirational insight is necessary to boost a growth mindset and a can-do attitude that would dissipate the current tendency to apathy felt by a jaded/disillusioned society:

> "Europe should engage in a **bold and daring exploration programme to reinvigorate European values and project European leadership beyond space**. Investing in leadership and autonomy can catalyze a wider **societal mobilization**, gearing Europe's society towards a **can-do attitude and unlocking optimism for the future**. Only a **truly transformative approach**, fostering a vibrant innovation ecosystem through private sector co-investment, new innovative financing structures, and challenge-based procurement can lead to **success**."[24]

lag_brochure.pdf, p. 7, consulted on June 10th, 2024. [Mazzucato Report]

[22] Mazzucato, M., Robinson, D. K. R., Market Creation and the European Space Agency: towards a competitive, sustainable and mission-oriented space eco-system, ESA Rerport, availbale online at: https://esamultimedia.esa.int/docs/business_with_esa/Mazzucato_Robinson_Market_creation_and_ESA.pdf, consulted on June 10th, 2024.

[23] Ibid.

[24] Mazzucato Report, supra, note 22, p. 29.

2.2. *Catch-All Terms: Do They Sound Nice Or Hollow?*

The EUSL preparatory works involve three pillars:

> "– The **safety** pillar would notably tackle the risks of collision (i.e., collision avoidance, spacecraft maneuverability, positioning in orbit) and generation of space debris (i.e., space debris mitigation plans), both for launchers and satellites.
>
> – The **resilience** pillar would put risk assessment and **security risk scenarios** at the heart of the EU space industry and enhance the level of protection in a consistent manner for all space infrastructure segments (ground, space and link segments).
>
> – The **sustainability** pillar would put in place the foundation for common rules to calculate the **environmental footprint of space activities, with a view to reducing the environmental footprint** in the long term."[25] (emphasis added)

Nonetheless, having a new law that talks about "safety", "resilience" and "sustainability" won't do. Not only are those buzzwords insufficiently visionary, but they truly serve as catch-all terms for anything space-related, which won't suffice to get away with.

Firstly, for example, the term "resilience" means, in science, to overcome an obstacle and emerge in a new and improved state (adaptation). However, in the space sector, it has become a stamp of approval for counter-attacking operations/capabilities such as deterrence, deception, strike, or whatever else is necessary to protect a given interest[26] and restore the previous state. The misuse of the term has become widely accepted, to the point of the misinterpretation's legitimacy taken for granted. In this restorative case, the correct term that should rather be used is "resistance"[27] instead of "resilience". However the former has a more belligerent nuance than the latter, which easily passes under the radar as being more constructive and

[25] Council of the European Union, Preparation of the Council (Competitiveness (Internal Market, Industry, Research and Space) on 23-24 May 2024, EU Space Law: Safety, resilience and sustainability of the space activities in the EU - Exchange of views, Brussels, 2 May 2024 (OR. en), 9370/24, available at: https://data.consilium.europa.eu/doc/document/ST-9370-2024-INIT/en/pdf, consulted on June 10th, 2024.

[26] USSF Space Systems Command, Race To Resilience, available at: https://www.ssc.spaceforce.mil/About-Us/Race-To-Resilience, consulted on June 10th, 2024.

[27] Rhimbassen, M., SPACE RESILIENCE 4.0, Contracting for Resilient Space Infrastructures, 2017 Manfred Lachs, IASL, McGill, available at: https://www.mcgill.ca/iasl/files/iasl/mlr_mlc_slides_resilience.pdf, consulted on June 10th 2024.

therefore less edgy politically speaking. Space means security and defense. It is all about missiles turned into rockets[28]. Why then pass a new law that basically recycles codes of conduct and "defensive" permissibility by updating the details and fine print? What's in it that's new under the sun? Is it transformational enough to rise in the eyes of European society for generations to come?

Secondly, the term "sustainability" is very fashionable now. Everything must be "sustainable", up to the point of becoming a value proposition in itself, which after all sounds nice. Indeed, it has a nice ring to it, but what does it mean precisely? There is already a whole bunch of space debris orbiting around Earth and launching massive mega constellations one after the other (e.g. Starlink, Project Kuiper, E-Space[29], etc.) only increases the collision risk, no matter how "sustainable" the architecture is. New space means privatization, which means that most of these infrastructures are/will be private (e.g. Starlink, Project Kuiper, e-space, etc.). However, if one of them goes bankrupt (e.g. OneWeb), mergers and acquisitions (M&As), and bailouts[30] are to be the ultimate salvation preventing our planet from becoming imprisoned by orbital debris[31].

An innovative financial reform should regulate this iterative scenario instead of passing new laws recycling space traffic management (STM) guidelines/standards[32]. Otherwise, the EUSL can prove to be more of a storm in a teacup; just a label "tagging" law[33], depending on how

[28] Friedling, M., Veber, M., Commandant de l'espace, Laffont, 2023.

[29] Cabirol, M., Greg Wyler: le come-back fracassant de l'enfant terrible du spatial, La Tribune, 05/11/2021, available at: https://www.latribune.fr/entreprises-finance/industrie/aeronautique-defense/greg-wyler-le-come-back-fracassant-de-l-enfant-terrible-du-spatial-895751.html, consulted on June 10th, 2024.

[30] Britain's government bailed out OneWeb in 2020. Now it's in trouble, The Economist,12/03/2022, available at: https://www.economist.com/britain/2022/03/12/britains-government-bailed-out-oneweb-in-2020-now-its-in-trouble, consulted on June 10th, 2024.

[31] Preault, V., Vercaemer, D., Les conquistadors de l'espace, Documentaire, Arte, 2023, available at: https://boutique.arte.tv/detail/les-conquistadors-de-lespace, consulted on June 10th, 2024. [Preault]

[32] European Commission, Space Traffic Management: Safeguarding space operations, available at: https://defence-industry-space.ec.europa.eu/eu-space/space-traffic-management_en, consulted on June 10th, 2024.

[33] Posaner, J., Space is the new 'Wild West.' The EU is dying to step in and regulate, Politico, 27/03/2024, available at: https://www.politico.eu/article/eu-wants-make-space-safe-law-label-boring/, consulted on June 10th, 2024.

transparent the tag is (e.g. what information is taken into account[34], is the supply chain clearly identified, are all the components identifiable and traceable?, etc.)[35]. On the one hand, labeling efforts are honorable, when fully transparent. On the other hand, when not, they are more of a concealing package, a cover-up.

> "Focusing on specific instruments, the use of a labeling system can be valuable. However, its suitability and effectiveness should not be overestimated either, especially considering that space is not a consumer-oriented market. **Similarly, it cannot be excluded that labels themselves could turn into a form of greenwashing** (...)"[36].

Moreover, the more space becomes privatized, the more opaque it becomes, especially when privatization turns to private equity[37] and where the shareholders' interest in maximizing profit becomes the main mission, regardless of the consequences."Green" strategies become a source of very lucrative speculation[38]. "Green" does indeed grow on trees, meaning that economic actors are using concepts of greenwashing and "environmentally friendly" value propositions within their business models to perfect and crystalise their quest for further speculative products, ever

[34] Chairopoulos, P., Stop aux contrevérités sur le Nutri-Score !, 60 Millions de Consommateurs,18/08/2022, available at: https://www.60millions-mag.com/2022/08/16/stop-aux-contreverites-sur-le-nutri-score-20323, consulted on June 10th, 2024; Blanck, J., Benamouzig, D., Rapport COLONUT, La controverse des logos nutritionnels : expérimenter pour légitimer un instrument contesté, Science Po, Chaire Sante, available at:
https://www.sciencespo.fr/chaire-sante/sites/sciencespo.fr.chaire-sante/files/Rapport%20Controverse%20logos%20nutritionnels%20VERSION%20PUBLIQUE.pdf, consulted on June 10th, 2024.

[35] Rapp, L., Rhimbassen, M., Orbital Debris Mitigation Getting Out of the "Space Sustainability Trap", IAC 2021 Conference Proceedings, available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4358755, consulted on June 10th, 2024.

[36] ESPI Report, EU Space Law: Contribution of the European Space Policy Institute to the public consultation on EU Space Law, 2023, available at: https://www.espi.or.at/wp-content/uploads/2023/12/ESPI-Feedback_EU-Space-Law.pdf, consulted on June 10th 2024.

[37] McCormick, P., Mechanick, M. J., The Transformation of Intergovernmental Satellite Organisations, Policy and Legal Perspectives, Series: Studies in Space Law, Volume: 9, Brill, 2013, available at: https://brill.com/edcollbook/title/24471, consulted on June 10th, 2024.

[38] Born, M., Girard, R., La Finance Lave Plus Vert, Documentaire, Arte, 2022, available at: https://educ.arte.tv/program/la-finance-lave-plus-vert, consulted on June 10th, 2022.

so increasingly specialized (e.g. better Earth Observation (EO) to monitor the climate crisis and therefore predict where to invest accordingly[39]; better connectivity provided by mega constellations to make that investment quicker[40], etc.). Meanwhile, hydrazine thrusters or other propellants used for launching rockets do pollute, rare earth metals extraction used for building satellites (or computers and data storage facilities, etc.) upset entire natural ecosystems and new massive constellations become a collision hazard, and so forth. This illustrates how, instead of sounding nice, the term "sustainability", rather does, in fact, sound hollow. It remains very commendable that the space community is aware and acknowledges the issue of the need for sustainable development, but to make it a pillar for future law will end up being a disservice, because the term "sustainability" is already losing its breath[41]. At this point, it might be a strategic error for Europe to commit to a law based on an "*effet de mode*" package which gives the "green" light to further mega constellations funding and security/defense missions. Mazzucato recommends in her report for the European Space Agency (ESA) that Europe must "Act Visionary, Act Differently, Act Now" to "leverage heritage, and invest more to shape the future" and that there is a "need for immediate action to secure opportunities"[42]. The EUSL does not seem to rise up to the challenge satisfactorily.

2.3. *Catch 22 vs Catching Light in a Bottle*

Mazzucato further sustains that, among others, Europe should be pursuing a new ethic for explored frontiers to "avoid repeating Earth-bound patterns"[43]. Likewise, Ezrachi goes in the same direction with regards

[39] Baker, E., Earth observation could drive US$3.8tn in economic growth by 2030, World Economic Forum reports, Meteorological Technology International, 07/05/204, available at: https://www.meteorologicaltechnologyinternational.com/news/satellites/earth-observation-could-drive-us3-8tn-in-economic-growth-by-2030-world-economic-forum-reports.html, consulted on June 10th, 2024.

[40] Osipovich, A., High-Frequency Traders Eye Satellites for Ultimate Speed Boost, Wall Street Journal, 01/04/2024, available at: https://www.wsj.com/articles/high-frequency-traders-eye-satellites-for-ultimate-speed-boost-11617289217, consulted on June 10th, 2024.

[41] Ferrari, E., et al.,How Sustainability Efforts Fall Apart, Harvard Business Review, 26/09/2022, available at: https://hbr.org/2022/09/how-sustainability-efforts-fall-apart, consulted on June 10th, 2024.

[42] Mazzucato report, supra, note 22, pp. 32-33.

[43] Ibid, p. 30

to competition law by making it "noble" to serve a purpose[44], because encouraging competition just for the sake of it ends up being "toxic". In the same vein, Mauborgne refers to this competition "overdose"[45] as a bloody "red" ocean[46]:

RED OCEAN STRATEGY	BLUE OCEAN STRATEGY
Compete in **existing** market space	Create **uncontested** market space
Beat the competition	Make the competition **irrelevant**
Exploit **existing** demand	Create and capture **new** demand
Make the value-cost trade-off	**Break** the value-cost trade-off
Align the whole system of a firm's activities with its **strategic choice of differentiation or low cost**	Align the whole system of a firm's activities in **pursuit of differentiation and low cost**

Figure 2: Blue Ocean Strategy VS Red Ocean Strategy[47]

Moreover, Frison-Roche elaborates in the same sense by setting "monumental goals[48]" to drive ethical compliance. All these recommendations can be combined together with space law since its main treaty (Outer Space Treaty of 1967) is based on a set of ethical principles[49]. Therefore, while

[44] https://www.law.ox.ac.uk/content/ariel-ezrachi

[45] Ezrachi, A, Competition Overdose: How Free Market Mythology Transformed Us from Citizen Kings to Market Servants, University of Oxford, 2020, Faculty of Law, available at: https://www.law.ox.ac.uk/content/ariel-ezrachi Ezrachi, consulted on June 10th, 2024.

[46] Kim, W. C., Mauborgne, R., Blue Ocean Strategy, Expanded Edition: How to Create Uncontested Market Space and Make the Competition Irrelevant, Harvard Business Review Press, 2015. [Kim]

[47] Blue Ocean Strategy website, available at: https://www.blueoceanstrategy.com/what-is-blue-ocean-strategy/, consulted on June 10th, 2024. [Blue Ocean Strategy]

[48] Frison-Roche, M.-A., (ed.), Compliance Monumental Goals, coll. "Compliance & Regulations", Journal of Regulation & Compliance (JoRC) et Bruylant, 2023, available at: https://mafr.fr/fr/article/compliance-monumental-goals/, consulted on June 10th, 2024.

[49] UNOOSA, Treaty on Principles Governing the Activities of States in the Exploration

space law is due to be closely intertwined with competition law (because of the internal market), the time is ripe to shape up the future of the space market ethically[50], while taking into account European values within the EUSL and the economic needs/purpose ("mission economy[51]").

The credibility/seriousness test also took a hit when the European consortium selected to build the "Breton" constellation[52] (IRIS²) is on the point of bursting[53]. The lack of coherence and consensus prevent the ship from going forward. What's to be done to catch a favorable wind and exit this stalemate and restore/ensure sovereignty (i.e. instead of relying again on SpaceX)? This places the EC in an uncomfortable position in terms of competition law, especially when it is so difficult to keep all the actors together and when European member states have divergent interests and end up accusing each other of unfair competition, while other actors take it on the chin and follow along with the imposed and controversial "just return" principle[54] which not only artificially restricts competition and funding for poorer member states, but freezes innovation opportunities.

Competition law in Europe is challenged by incoherence as the Commission sometimes goes as far as invalidating member states' domestic rulings[55]. Furthermore, the European Union (EU) is based on an

and Use of Outer Space, including the Moon and Other Celestial Bodies, 1967, available at:
https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html, consulted on June 10th, 2024.

50 Rhimbassen, M., From Toxic to Noble Competition: Implementing A New Perspective of Antitrust in Outer Space based on Ethics and Beyond, Open Lunar Foundation, 10/02/2022, available at: https://www.openlunar.org/research/from-toxic-to-noble-competition, consulted on June 10th, 2024

51 Mazzucato Report, supra, note 22.

52 Hamon-Beugin, V., Tout savoir sur Iris2, la future constellation de connectivité sécurisée de l'Union européenne, Usine Nouvelle, 18/11/2022, available at: https://www.usinenouvelle.com/article/tout-savoir-sur-iris2-la-future-constellation-de-connectivite-securisee-de-l-union-europeenne.N2068337, consulted on June 10th, 2024.

53 O'Reilly, T., Un différend franco-allemand menace de faire dérailler le programme Internet par satellite de l'UE, Atlantico, 04/05/2024, available at: https://atlantico.fr/article/decryptage/un-differend-franco-allemand-menace-de-faire-derailler-le-programme-internet-par-satellite-de-l-ue-thomas-o-reilly, consulted on June 10th, 2024.

54 Meddah, H., 0, 1, 2, 3…ans de retard, le mauvais compte à rebours d'Ariane 6 qui fragilise l'Europe spatiale, Usine Nouvelle, 20, 10, 2022, available at: https://www.usinenouvelle.com/article/0-1-2-3-ans-de-retard-le-mauvais-compte-a-rebours-d-ariane-6-qui-fragilise-l-europe-spatiale.N2057767, consulted on June 10th, 2024.

55 Dobosz, K., National competition law – time to say goodbye? Jean Monnet Network on EU Law Enforcement

internal market, with its pros and cons, especially from a competition law perspective. The same principle will apply to the future internal market in the European space sector, particularly when nowadays space is gradually transitioning towards a business-to-consumer (B2C) market (e.g. Starlink). Is Europe ready for that? The answer is: not really: Ariane 6, IRIS², and now the EUSL (perhaps the European elections will impact the process) are on the rocks. Meanwhile, SpaceX and Starlink are watching. And if anyone needs to take the blame for space debris, the EC can always, on the other hand, point the finger to Musk, while, on the other hand, ask SpaceX to fill in for Ariane. This is highly problematic. As mentioned, this unconvincing behavior is uninspirational. Europe already recognized the fact that a paradigm shift is much needed in terms of sense of purpose[56].

3. *Catch Me if You Can: Blue Space*

Strategic audacity is much needed in building a "bold" roadmap to shape up the future based on values[57] by not only catching up with competition but rather drowning it within a "blue ocean"[58]. Differentiating "sustainability" from today's misalignment and repositioning Europe's goal towards "stewardship" to "generate belief in the future" is essential to trigger optimism, will and a can-do attitude: "this feeling is a necessary basis for confidence in our ability to take responsibility and shape the world positively"[59]. It is necessary to give meaning to an otherwise bureaucratic institutional inertia that especially characterizes the European space programme/policy at large.

It is a catchy business to be bolder than bold[60] and think up a:

Working Paper Series, Working Paper Series No. 27/22, available at: https://jmn-eulen.nl/wp-content/uploads/sites/575/2022/05/WP-Series-No.-27-22-National-competition-law-%E2%80%93-time-to-say-goodbye-Dobosz.pdf, consulted on June 10th, 2024.

56 Mazzucato Report, supra, note 22

57 Ibid, p. 29.

58 Kim, supra, note 47.

59 Mazzucato Report, supra, note 22, p. 24.

60 Diamandis, P., Kotler, S., Bold: How to Go Big, Create Wealth and Impact the World (Exponential Technology Series), Simon and Shuster, 2016, available at: https://www.diamandis.com/bold, consulted on June 10th, 2024.

> "clear **challenge-oriented public action towards a common goal**. In this regard, the **directionality**, and conditionality of public investment are crucial to avoid monopolies and dependencies on individual actors (...) But most importantly, private investment and engagement will only happen if the **public sector commits to a clear vision** and associated strategy (...) **Public and private actors have a responsibility to get out of their respective comfort zones.**[61] (emphasis added)

Public sector governance (governments, together with the EC, ESA member states, etc.) must get together and set "mission-oriented approaches that are powerful generators of benefits" by "aligning missions to sustainable development goals can allow targeting the biggest socio-economic and environmental challenges we face today", thus "co-creating and co-shaping markets to help tackle the challenges faced while enabling economic growth"[62]. This perspective confirms that sustainability is not an end in itself, but a means for the greater mission.To do this, Mazzucato explains that:

> "There is a **need, at political level, to reanimate and enhance the continent's communal identity, and implant a new sense of hope and optimism in its population for a commonly shared future**. The next generation, faced with **uncertain futures, needs to be inspired and empowered** to design, drive and implement European ambitions."[63] (emphasis added)

Moreover, States must reappropriate their leadership in the innovation process, where pioneering technology has been in the early stages designed and funded by the public sector (e.g. the internet, nanotech, biotech, cleantech, etc.). Therefore, it is hard to justify that space innovation is now accelerating disruptive innovation since most of it has been growing on the shoulders of giants (meaning states with transformative, catalytic, mission-oriented public investments[64]), delegating the lot to the private sector as soon as it lucratively took off and stopped fearing catching a cold (from the

[61] Mazzucato, supra, note 22, pp. 26-27.

[62] Ibid, p. 28.

[63] Ibid, p. 30

[64] Mazzucato, M., Building the Entrepreneurial State: A New Framework for Envisioning and Evaluating a Mission-oriented Public Sector, Working Paper No. 824, Levy Economics Institute of Bard College, January 2015, available at: https://www.levyinstitute.org/pubs/wp_824, consulted on June 10th, 2024. [Mazzucato, 2015] p. 3.

disruptive nature of the said innovation)[65].

Therefore, Europe should "create" markets rather than just "fixing" them[66]. Fixing market failures deprives the state of the "directionality (...) required for innovations"[67] and high risk strategies. Therefore, policy must be seen as an enabler for "market creation" and "shaping process" for "mission-oriented investments" instead of the current *ex post* (passive) role of being the "fixer" of private errings.

At this point, innovation needs to be holistic, meaning more socioeconomically inclined and not just technical:

> However, **grand societal challenges concern the socioeconomic system as a whole**, which often implies **large-scale transformations** (....) This is in stark **contrast to the missions of the past, which were mainly technical** (...) For example, NASA's mission-oriented programmes for innovation have historically been driven by security concerns and by the need to maintain technical leadership over other nations. This situation is **now changing.** NASA is seeking to **create new markets**, with a clear focus on fuelling a sustainable Earth-LEO economy (...)[68] (emphasis added)

What will Europe's take on this be? Since the US is targeting supreme leadership within an Earth-LEO economy, will Europe (as it seems it will) struggle to compete and catch up in that same market, using the same methods, but at a smaller scale, or will it go beyond and create a whole new market (since LEO is becoming congested and Europe hardly keeps up)? What will it be? Will Europe be able to get together and opt for a "blue ocean strategy[69]" by defining a new market entirely, creating thus a "blue space" strategy? For that to succeed, the EUSL entire process must be restarted and be more inclusive, transdisciplinary and transparent, particularly to calm down the growing unrest at the European level. Otherwise, it's destination void.

---

[65] Ibid, p. 2.

[66] Ibid, p. 4.

[67] Ibiid.

[68] Robinson, D. K. R., Mazzucato, M., The evolution of mission-oriented policies: Exploring changing market creating policies in the US and European space sector, Elsevier, 2018, available at: https://www.sciencedirect.com/science/article/pii/S0048733318302373, consulted on June 10th, 2024.

[69] Blue Ocean Strategy, supra, note 48.

4. *Conclusion*

Instead of wasting time and resources over mimicking other actors' take on the market and making incoherent decisions to fight competition, Europe should start over, from an "entrepreneurial" standpoint, with a clear mission-oriented purpose, based on European values and ensure a communal mobilization around one and the same goal on the long run. The EC should rethink its pillars by organizing transdisciplinary consultations and workshops based on design thinking or other creativity management tools to think up future missions that interlink space, society, the economy and finance, the environment and so forth. In so doing, the Commission should also rethink its competitiveness logic, strategy and legal framework and become an enabler of fair competition while protecting European and member states' interests and consumers' wellbeing as well as values, which would empower consumers to think of themselves as active citizens instead of just passive consumers.

All in all, the marketization of space seeks to protect the *market*, but without changing its purpose, which ends up in toxicity, as Ezrachi points out. Today's internal market in Europe creates much turmoil both among the public and private sectors, but mostly among consumers who suffer from concentration/monopolization and, consequently, lack of choice. If this internal market gets replicated in the space sector, or vice-versa, there will be nothing new under the sun after all… and the EUSL risks becoming just one more legal layer to add to the institutional inertia which is already crumbling under its own weight. Space is not just another part that should be played by M&A rules. The EC should be the first to know that. As it stands, the Commissioner for the internal market is at the helm of the EUSL, but the steering core should include the Commissioner for Competition to ensure a more coherent approach to space autonomy and competitiveness, from a communal perspective, as well as economists and scholars from different backgrounds and schools of thought to have more hands on deck and to ensure that the helm does not steer towards one nation or the other's industrial *intérêt*, because anyone of these would then go it alone, in the end. Not to mention that with the former Commissioner Breton now gone[70], who

[70] Mathieu, B., *"Thierry Breton : les coulisses de son départ fracassant de la Commission européenne"*, L'Express, 16-09-2024, available at: https://www.lexpress.fr/economie/politique-economique/thierry-breton-les-coulisses-de-son-depart-fracassant-de-la-commission-europeenne-HVEDBRFWB5BELNKEUI5ONYFSXM/. Accessed on

knows what's next. Destination unknown, which says it all...

18-09-2024; Grably, R., *""Bon voyage": Elon Musk ironise sur le départ de Thierry Breton, qui lui répond"*, BFM, 18-09-2024, available at: https://www.bfmtv.com/tech/twitter/bon-voyage-elon-musk-ironise-sur-le-depart-de-thierry-breton-qui-lui-repond_AV-202409180570.html. Accessed on 18-09-2024.

Mario Ricca

Space Is More than 'Human Being'. The Anthropological/Cognitive Untimeliness of Contemporary Claims to Rights over Outer Space

Summary: 1. What does 'common' mean in outer space? – 2. Weightlessness and Void: Psycho-cognitive and pragmatic implications – 3. The hidden proxemics of legal categories and its collapse into outer space – 4. Conclusion: a gaze from without toward "the little threshing floor which makes us so ferocious".

1. *What does 'common' mean in outer space?*

The issue of 'global commons' has recently entered orbit. Among the latest acts in the truly sci-fi mini saga about exploiting the resources of outer space and celestial bodies is the issuance of U.S. Executive Order No. 13914/2020.[1] The 'merits' for triggering the topic actually go to U.S. President Barack Obama. In 2015, Obama signed the U.S. Commercial Space Launch Competitiveness Act (H.R.2262). This unilateral regulatory act is an attempt, no more and no less, to circumvent the implications of the 1967 Outer Space Treaty, which prohibited any Earthly claim to national sovereignty over celestial bodies. The distinction—worthy of Jesuit Casuistry[2]—is between sovereignty over the surface of celestial bodies and private property rights over the resources extracted from them by for-profit companies. In this way—thus the political rhetoric that accompanies this regulatory initiative highlighted—the U.S. could fulfill all of its previous

[1] See Trump's Executive Order 13914 on "Encouraging International Support for the Recovery and Use of Space Resources." This order addresses U.S. policy regarding the recovery and use of resources in outer space, including the Moon and other celestial bodies.

[2] My referral is strictly ironic. However, for a re-assessment of Jesuit Casuistry see, most recently, J. Smith, D.Q. Tran, *Jesuit-Informed Casuistry and the Role of Principles for Organizational* Ethics, in «Philosophy of Management» 22, 2023, pp. 73–98. https://doi.org/10.1007/s40926-022-00208-1.

international commitments. I only add for the record that from 2015, through 2020 and up to the present, U.S. 'foresight'—a real political presbyopia—has raised great interest, fierce criticism, and unquenchable debate.[3]

My brief contribution will focus on the anthropological-legal aspects of the above issue, not least because the technical-legal aspects of the diatribe are covered extensively by all the authors who contributed to this collection.

One of the most debated topics is related to the legal qualification of celestial bodies and the resources that may be extracted or otherwise obtained through their exploitation. More specifically, and with regard to previous United Nations normative categorizations, the question has arisen as to whether or not celestial bodies fall under the so-called 'Global Commons.'[4] The literature on the subject has quickly become vast. Nonetheless, among the jurists who have dealt with the topic, almost no attention has been paid to the anthropological aspects of relations between humans and the extra-terrestrial environment (and between humans who are outside the Earth or project their interests there). For this reason, I believe that determining what is common in outer space in relation to the claims of human beings and how to regulate them through law requires some preliminary investigation. More specifically, I believe that it is of primary importance to preemptively focus on the relationship between subject and object from an anthropological-semantic perspective when discussing human experience outside the Earth. The main issue, in my view, is not whether 'something' is 'in common', that is, whether it should

[3] In this regard, for a first approach, it may be useful to consult the recent review by R. Kaul, *Outer Space – Is it a Global Commons?*, in «Front. Space Technol.», 5, 2024. doi: 10.3389/frspt.2024.1411610, available at https://www.frontiersin.org/journals/space-technologies/articles/10.3389/frspt.2024.1411610/abstract. But also see D. Mei, *Integrating Outer Space as a Global Commons with Private Property Rights to Outer Space Resources*, in «Front. Space Technol. – Sec. Space Economy», 2024, 5. https://doi.org/10.3389/frspt.2024.1351850. An interesting repertoire of the manifold linguistic uses of the formula 'Global Commons' can be found in P. Pic, P. Evoy, J.-F. Morin, *Outer Space as a Global Commons: An Empirical Study of Space Arrangements*, in «International Journal of the Commons», 17(1), 2023, pp. 288–301. Available at: https://doi.org/10.5334/ijc.1271.

[4] As is well known, the United Nations has defined Global Commons as High Seas, Atmosphere, Antarctica and Outer Space, respectively. For a detailed discussion of this classification see at the following link: https://www.un.org/en/development/desa/policy/untaskteam_undf/thinkpieces/24_thinkpiece_global_governance.pdf. More in general, in the vast literature on Global Commons, see M. Byers and A. Boley, *Who Owns Outer Space?: International Law, Astrophysics, and the Sustainable Development of Space*. Cambridge University Press, Cambridge, 2023. doi: https://doi.org/10.1017/9781108597135, 2023; M.K.D. Cross, *Outer Space and the Idea of the Global Commons*, in «International Relations», 35, 2021, pp. 384-402.

be used equally, whether it can be exploited for commercial purposes, etc. Rather, the preliminary concern for all these discussions is to determine what is 'that thing' that the law is required to qualify as 'common' or not. In raising the above question, I do not at all intend to propose an ontological mapping of celestial bodies or outer space items. On the contrary, I believe the main goal should be to avoid projecting the 'features' that give 'thinghood'—as it were—to anything considered an 'object' on Earth, or from Earth's perspective, into outer space. With this statement I am trying to highlight how everything that is not the human subject and that can be considered as belonging to the category of 'commons' is the result of a relationship. More specifically, I am referring to the dynamic and interpenetrative relationship between the human being, or the mind/body unit, and what populates its environment. I define this relationship as dynamic—or enactive—in the sense that its elements do not precede the relationship but are themselves the result of ongoing and mutually transformative interpenetration. From this perspective, the only reality is the relationship itself. Its wings or components can only be isolated operationally and contingently. For this reason, it is not sufficient to speak of the relationship between the human subject and its context, as if the former pre-existed the latter. In outer space, the human being and the 'surrounding' context deeply co-determine and transform each other (of course, especially human beings and their bodies). The main implication of this argument is that in order to define something as 'common' to human beings we should first understand what human beings are involved in, and what results from the relationship with that 'something', as well as the impact on the overall relational environment in which they interplay.

The last statement directly entails another issue endowed with enormous anthropological import. Can we assume a 'common' human nature as previously existing when we talk about the experience of human beings in outer space? And in case this common nature exists, what is it? What would its properties, qualities, etc. be? Can we assume that at least its elemental traits are identical to those that human beings experience on Earth? And, therefore, that under these conditions Earth's legal rules— which, moreover, are decidedly culturally different from one country to another on Earth—could also be applied to humans in outer space? What if, instead, the supposed 'common human nature'—even definable as homologous anthropological characteristics—in outer space turns out to be different? Could legal rules remain the same despite these subjective-environmental changes?[5] Would their application to such

[5] In this regard, I believe that human beings must be very careful to produce a

radically different situations produce effects in line with their original prerequisites of legitimacy? Could they, in other words, be considered legitimate in terms of reasonableness, and therefore with regard to the means-ends relationship? Or even in terms of rationality, considering that those legal rules would operate relying on aprioristic epistemological assumptions which have been previously molded on Earth and not under the boundary conditions of outer space experience?

The set of considerations now proposed leads me to conclude that the debate on the global commons applied to outer space and what makes it up is affected by a kind of inappropriate anthropological-cognitive 'leap forward.' In my view, what is 'common' in the idea of 'global commons' as applied to outer space has yet to be invented. Indeed, what is 'common' in the idea of 'global commons' as applied to outer space has yet to be *discovered*, if not even invented. From an anthropological-legal point of view, I would say that with respect to outer space what we can recognize as 'common' is the ability of human beings to creatively relate to the environment and thus to 'engender' horizons of semantic universalization: which is a prerequisite for the determination of *what* is in common, first among legal subjects and then among their relations to the 'objects' (of those subjects).

In the next few paragraphs, I will try to provide some examples that can make more 'tangible'—especially for jurists—the practical implications of the anthropological and epistemological issue of defining what 'commons' *are* but, likewise, also what 'commons' *are not,* or, what is available for individual use or exploitation. First, however, I would like to invite the reader to dwell on two crucial aspects of the experience carried out by human beings in outer space so far. I am referring, respectively, to the absence of gravity and the meaning of the expression 'void space.'

semantization of experience in outer space by resorting to analogy with what happens on Earth and particularly in some so-called extreme terrestrial environments: see, for example, S.L. Bishop, *From Earth Analogs to Space: Getting There from Here*, in D.A. VAKOCH, (ed.), *Psychology of Space Exploration: Contemporary Research in Historical Perspective*, NASA, Washington, 2011, pp. 47-77; S. Dalledonne, *International Environmental Law and Environmentally Harmful Space Activities: Learning from the Past for a More Sustainable Future*, in «Journal of Property, Planning and Environmental Law», 13, 2, 2021, pp. 139-151. https://doi.org/10.1108/JPPEL-09-2020-0040. Some interesting critical insights on this topic can be found in E. Mendenhall, *Treating Outer Space Like a Place: A Case for Rejecting Other Domain Analogies*, in «Astropolitics», 16 (2), 2018, 97–118. doi:10.1080/14777622.2018.1484650; M.J. Peterson, *The Use of Analogies in Developing Outer Space Law*, in «International Organization», 51(2), 1997, pp. 245-274. doi:10.1162/002081897550357.

2. *Weightlessness and Void: Psycho-cognitive and pragmatic implications*

Beyond brief excursions to lunar soil, the experience in outer space of humans, more specifically astronauts, has so far coincided with being in Earth's orbit aboard spacecraft or space stations. Around the planet Earth, human bodies *almost* float in weightlessness. More precisely, astronauts experience a kind of perception of perpetual falling, due to Earth's curvature. Under those conditions, proprioception and the management of bodily movements in the surrounding space change profoundly. But, perhaps, to say that both *cannot avoid* profoundly changing would be more correct. The so-called bodily homeostatic values are placed under stress. The same fate, however, befalls the dynamic and interactional aspects of the 'being' in space of the human body and in its dynamic projections through it. In their diaries, astronauts openly say that in space, especially because of the absence of gravity, they feel as if they have become children again. They find themselves in the strange situation of having to relearn almost everything, especially the simplest activities, even those that correspond to the habits they have developed since childhood. Moving around inside the space station, for example, and then grasping objects, drinking, using the toilet, interacting with other bodies, etc., all become complicated operations that must be handled shrewdly and after proper training. Little use is made of the hours of preparation performed on Earth or inside the special airplanes flying in the upper layers of the atmosphere. Out there, things change. Many astronauts confess that when new crew members arrive who have never previously been on the space station, for the first fifteen days they are considered as 'PHO:'[6] and this is precisely because of their inexperience in handling their own bodies in the new environment. Actually, in orbit there is no 'ground.' Things do not stand still. The proxemics of human bodies related to objects is dramatically altered. For this very reason, everything implicit in the categorization of objects, including their relations with the human body, suddenly becomes uncertain. As a consequence, the implicit must be brought to the fore, made conscious and then consciously re-calculated with respect to the human subject's intended ends.[7] The operation is so difficult that many

[6] PHO is an acronym for Potential Hazardous Objects, a subcategory of NEOs, or Near-Earth Objects. NEOs are defined as PHOs if they are larger than 140 meters and their orbit crosses Earth's orbit.

[7] I have addressed all these anthropological-proxemic issues in M. Ricca, *Cultures in Orbit, or Justi-fying Differences in Cosmic Space: On Categorization, Territorialization*

astronauts ask others to observe them from the outside in order to tell the 'owner of the observed body' if they are doing something 'wrong.' In a sense, it could be said that no one feels complete ownership of their body anymore. And not only that: they ask for the cooperation of the minds of others to understand what their mind is doing with their own body... *behind their back*. Clearly it is difficult in this situation to answer questions such as: what is my body? What is its relationship to objects? What is the relationship between objects and my body? How can I categorize this relationship, and thus my body and the objects involved with it, so as to plan the realization of my ends? And what are my very ends, what is their meaning, if the means of achieving them (including my body itself) change in their meaning and scope?[8]

Without anticipating anything, I would only ask the reader to think about what words such as possession, ownership, or even contingently holding something might mean under the conditions of semantic and pragmatic uncertainty coextensive with the epistemic source of the above questions. And again, for example, in an environment where everything is in motion, nothing stays in place, how do you distinguish movable objects/goods from immovable objects/goods for the purpose of ownership and rights in rem? In that 'outer world', what is the 'common' underlying the potential 'commons'? And in what way? What are the relational and anthropological prerequisites of its 'mean-*ing*' and therefore its 'being'?[9]

Another major profile of anthropological transmutations in outer space concerns the experience of 'empty space,' that is, the void. The semantic remolding that the idea of 'emptiness' undergoes outside Earth

and Rights Recognition, in «Int J Semiot Law», 31, 2018, pp. 829–875. https://doi.org/10.1007/s11196-018-9578-5

[8] In my view, an extraordinarily relevant cognitive approach to this phenomenon is 'enactivism.' In this regard, see E. Di Paolo, E.C. Cuffaro, and H. De Jaegher, *Linguistic Bodies: The Continuity between Life and Language*, The MIT Press, Cambridge, MA – London, 2018; E. Di Paolo, *Enactive Becoming*, in «Phenom Cogn Sci», 20, 2021, pp. 783-809. https://doi.org/10.1007/s11097-019-09654-1, E. Di Paolo, Ezequiel, H. De Jaegher, *Enactive Ethics: Difference Becoming Participation*, in «Topoi», 41, 2022, pp. 241-256. https://doi.org/10.1007/s11245-021-09766-x. For further references to literature on enactivism and a specific analysis of its implications for legal theory and practice, see. M. Ricca, *How to Undo (and Redo) Words with Facts: A Semio-enactivist Approach to Law, Space and Experience*, in «Int J Semiot Law», 36, 2023, pp. 313–367, https://doi.org/10.1007/s11196-022-09912-7

[9] The use of italic in the hyphened word 'mean-*ing*' serves to emphasize the processive relationship that exists between means and ends and its relation to the production/emergence of meaning.

has extraordinary implications for law. On Earth, the idea of 'emptiness' seems to have a predominantly negative signification. In the common understanding, it stands for absolute absence, at least at first glance. Actually, on closer examination, that absence is not without specification. An empty space is one without obstacles. More precisely, it is a space that does not hinder human action as well as the free action of all moving bodies. This relationship between emptiness and human action suggests that space, and particularly empty space, is a semantized dimension or, to put it differently, a horizon of possible actions and meaningful experiences.[10] This means that the vacuum is not absolute—according to the meaning of classical physics—but rather functional to the action and cognitive projections of human beings. In a sense, it could be said that to be anthropologically empty, space must be at least potentially full of meaning and pragmatic possibilities. The absence co-extensive with the common idea of 'void' is indeed a presence albeit only a potential one, that is, a semiotic one. The void is semiotically filled with possible objects, actions, events, which are taken as signs. And only on this condition are humans able to think of it as 'void:' somewhat like a receptacle (relatively) amenable to being filled with the pro-active projections of the 'human.' Therefore, even what human beings consider to be 'empty' and external turns out to be the result of previous (experienced) relationships between the mind/body units and the environment. At this point one might ask: What does this have to do with space? And, more crucially, with the legal regulation of human action in and through it?

The answer lies in a seemingly paradoxical consideration. Interplanetary and interstellar outer space is only apparently empty. Actually, outer space is not really empty since it is traversed by cosmic radiation, neutrino beams, etc., which are simply not visible to the naked eye. However, taking the human body as a reference system, outer space is certainly emptier than empty space on Earth. Out there, for example, there is no air and therefore no resistance to movement either. Concrete experience in outer space outside of Earth, however, proves exactly the opposite. If an astronaut exited the spacecraft or space station wearing the clothes they use on Earth, they would cease to live in a very short time. Outer space is so empty that it is full for a human being. Without wishing to be sarcastic, I would be inclined to say that in the controversy over the 'Global Commons' in outer space

[10] I have analyzed space experience from a chorological perspective and qualified 'space' as a semantic dimension in M. Ricca, *Intercultural Spaces of Law: Translating Invisibilities*, Springer, Cham, 2023. I refer to this book for an in-depth discussion of this topic and the related literature.

human beings should start from an almost certain probability: what they have most in common out there is the chance to die. Whatsoever they set out to do requires a prior strategy to avoid what would *most naturally* happen to any human body: death produced by the hostile environmental conditions. Consequently, if 'emptiness' in the common sense and from the psycho-pragmatic point of view means 'absence of obstacles,' then the *quasi-void* of outer space is the *ultimate* obstacle. In order to act in outer space without perishing, humans must 'make space for themselves', that is, they have to 'invent' it. The anthropological and semantic implications stemming from this need and its fulfilment are simply immense. This immensity, on the other hand, pervasively also penetrates the legal dimension. Insofar as space is to be 'invented,' everything that occupies it will go through semiotic-relational turmoil. Objects, gestures, etc., if transferred/translated from the Earth to outer space, will have different meanings because the relational environment with which they will have to interplay will be deeply 'other'. Once again, it is to be emphasized that this interaction is not between 'items' already endowed with their ontological semantic structure. On the contrary, the meaning and, even before that, the categorization of those items will be precisely the result of such relational interaction. Each 'item' will appear different to such an extent that it will embody different relationships from those which are experienced on Earth. I will immediately try to make this dynamic of semantic change explicit in the simplest way.

When human beings think of an 'object' (e.g., a piece of fruit), especially in Western culture, they are prone to identify its meaning with its visible form. However, this visible dimension is only a kind of 'buoy,' a 'signpost,' which serves to activate in our mind/brain unit all the relationships and implications related to that image. The meaning of the 'fruit' image is the set of those relations, which also include human beings, their senses, biological values, purposes, bodily predispositions, behaviors, beliefs, knowledge, etc. On average, all those relationships remain implicit, in the background. This happens either because of the meaning or the pragmatic or ideal value of that 'item.' The same applies to its economic value. As soon as the underlying relations change, however, gradually the economic value, the pragmatic value and, finally, the meaning itself will also begin to change. Much depends on the scope of the changes that the underlying relations incur. From a legal point of view, the change in the previously underlying relationships has an enormous impact on the legal relevance of all 'items:' be they 'objects,' 'behaviors,' 'events,' each corresponding to 'different goods.'[11] This is because each of the underlying relationships

[11] The philosophical-semiotic antecedents – so to speak – of the relational approach to

involves (semiotic) aspects, elements, profiles potentially endowed with legal significance. Changing relationships and what is involved in them or transformed by their changes will result in new combinations of norms, principles, values (a phenomenon that is all the more extensive in multilevel legal systems). This normative change will, in turn, project into social experience. In many cases, it will eventually merge with 'being' immanent to it, thus changing the meaning of any 'items.'

The relationship between relational change, experience in outer space, remolding profiles of axiological/teleological and legal relevance, and finally meaning is pervasive and, in many ways, may prove really astonishing. Thus, for example, if different relationships are prospectively and retrospectively connected to one type of 'item' when it is experienced in outer space, then that item will change in its meaning and, at the same time, in its legal relevance profiles. In short, its becoming another 'good'—and thereby a 'legal good'—and its becoming another 'item' will eventually conflate. The changes that the boundary conditions of outer space may produce—first of all the absence of gravity—are not predictable a priori or, at any rate, by relying on previous earthly experience.[12]

In the next section I will try to provide some examples of the unpredictability of change based on some of the institutions and categories of positive law. It is my intention that this kind of anthropological-legal analysis serve to more cautiously and much more reflectively assess the variables and presumed semantic and pragmatic constants involved in the issue of 'global commons' as applied to outer space.

---

categorization and meaning proposed in the text can be traced, variously, in C.S. Peirce, *Collected Papers*, Voll. 1-8, Belknap Press, Cambridge (MA), 1965-67; J. Dewey, *Logic: The Theory of Inquiry*, Henry Holt and Co., New York, 1938; Id., *Experience and Nature*, Dover Publications, New York, 1958 (or. 1925), J. Dewey, A.F. Bentley, *Knowing and the Known*, Beacon Press, Boston, 1949; A.N. Withehead, *Process and Reality*, Free Press, New York, 1985. This approach has been taken up by contemporary enactivism, among others (see above in nt. 8).

12 It may be useful for the reader to compare the considerations in the text with those proffered by F. Ferrando, *Why Space Migration Must Be Posthuman*, in J. Schwartz, T. Milligan, (eds.) *The Ethics of Space Exploration. Space and Society*. Springer, Cham, 2016, pp. 137-152. https://doi.org/10.1007/978-3-319-39827-3_10 . For an anthropological approach to the human/post-human dialectics that could be triggered by outer space and extraterrestrial experience, see D. Valentine, *Gravity Fixes: Habituating to the Human on Mars and Island Three*, in «Hau: Journal of Ethnographic Theory» 7, 3 2017, pp. 185–209. Also see D.A. Vakoch, (ed.), *Psychology of Space Exploration*, cit.; see also the renewed edition of this book: Id., (ed.), *On Orbit and Beyond: Psychological Perspectives on Human Spaceflight*, Spinger, Berlin-Heidelberg, 2015.

3. *The hidden proxemics of legal categories and its collapse into outer space*

Law regulates the actions of human beings. But these actions unfold into and through space. Any legal rule therefore presupposes space and the possibility of filling it, bending it, with human actions. The set of these possibilities—as we have seen—semantically shapes space. In this respect, then, law constantly presupposes and reshapes 'the space of meanings' and 'the meaning of space' in which human beings live. In outer space, many environmental constants extant on Earth, such as the presence of air or the absence of an atmosphere, change. The implications of these diversities with respect to earthly boundary conditions are gigantic, to say the least. The absence of gravity is among the most spectacular and incisive. For illustrative purposes only, I will focus on this condition and its legal implications.

In order to show concretely how the categories of law change and may even be distorted, for example, in zero gravity condition—or even, in the hypothesis of life on other planets, in different gravity conditions—I will refer to some basic legal categories. In doing this, I will attempt to make visible how the proxemics—that is, the categorization of spatial relations between the human body and objects, as well as between human bodies—which law presupposes and regulates could change in outer space. In this regard, I would like to use a classic of legislative production.

a) By 'a classic of legislative production' I am referring to the Code Napoléon[13] and specifically its property provisions. I will quote a few articles here, asking the reader to imagine how they might apply—or, rather, prove unsuitable—for the regulation of human conduct in outer space.

Consider the following articles:

> 516
> All property is moveable or immoveable
>
> 517
> Property is immoveable either by its nature, or by its destination, or by the object to which it is applied

[13] The English translation of the Code Napoléon articles below is taken from Code Napoléon (literally translated from the original and official edition) London, William Benning, 1827. Also available at: http://files.libertyfund.org/files/2353/CivilCode_1566_Bk.pdf
I decided to use here the original text of the Code Napoléon—regardless of subsequent amendments—to give a sense of the temporal gap between the origin of many legal categories still in vogue and the even 'extraterrestrial' present of humankind.

> 518
> The soil of the earth and buildings are immoveable by their nature
>
> 528
> Moveable in their nature are bodies which may be transported from place to place, whether they move themselves like animals, or whether like inanimate things, they are incapable of changing their place, without the application of extrinsic force.
>
> 539
> All property unclaimed and without owner, and that of persons who die without heirs, or of which the succession is abandoned, belongs to the nation.
>
> 542
> Common property is that of the ownership or produce of which the inhabitants of one or more communes have an acquired right.
>
> 544
> Property is the right of enjoying and disposing of things in the most absolute manner, provided they are not used in a way prohibited by the laws or statutes.

A few brief comments will suffice to show the proxemic, and therefore anthropological, problems that an application of these norms in zero gravity would pose. Consider articles 516-518 and 528. Article 516 states that property is movable or immovable. This phrase is meant to specify that property may involve movable or immovable things. But, in this regard, I cannot avoid raising a rather trivial but inescapable question: what is immovable in outer space under conditions of zero gravity? Actually, out there, everything is on the move. (The last sentence is to be accompanied by the clarification that, in general terms, nothing in the universe is definitively stable; it can only be relatively stable. But in extraplanetary space even this relative stability almost vanishes).

With regard to the 'Global Commons' qualification of celestial bodies, what kind of common or individual ownership would this be? Is an asteroid, a meteorite, mobile or immobile? And how to distinguish the asteroid from the 'movable things' that could be mined? How can one determine the right of ownership or exploitation over something that is perpetually in motion and can only be reached by traversing empty space by means of actions that may have implications for what belongs to others or should belong to no one? Will some form of property easement or right of way have to be imagined? But how, and with what relational implications? For example, how to imagine a route to an asteroid, considering that that route will constantly change? How to imagine it in terms of exclusivity or individual enjoyment? Precisely in this regard the problem of anthropological-proxemic turmoil comes to the fore. How should real estate rights that directly or indirectly refer to the human body or its technological prostheses/technological in 'a space' where there is nothing immovable be configured? Or should we perhaps rethink from scratch the category of real estate and even property in view of the changing relational dynamics of the landscapes surrounding the 'good' or 'asset' at stake? If this were the case, however, and for the reasons already proffered, it would also change the meaning of the 'legal good,' and thereby also the good's 'enjoyment' as well as the 'material object' of the legal relationship to outer space (to be defined). Such work would require the semantic-pragmatic reshaping of much of the background on which law, and property rights in particular, are based. This background, however, also houses the categories, the habits, that are constitutive of the idea of 'human.' This means, moreover, that the change would also inevitably impact the idea of what is 'common or universal' among human beings: thus, their needs, their prerogatives, their rights. Beyond the critique of the idea of so-called 'natural rights,' human nature should be reinterpreted, in a sense reinvented. Human rights should be figured as 'unnatural,' that is, 'in-natural,' in the sense that they should no longer be thought of as exclusively embedded in earthly nature (both human and non-human).[14]

To get back to the Code Napoléon, consider now Article 539. Under what conditions could we speak of a thing abandoned or without an owner in outer space? It could be answered that in outer space humankind owns everything. The assertion, however, immediately appears rather pretentious. Space—as it turns out—is much more than human beings and their earthly nature, to say nothing of their current ability to understand it. On the other hand, this is the same problem that underlies the definition of 'commons' and, even before, simply 'common to humanity' in outer space.

What seems to me to emerge with relative sharpness from the above remarks is that the 'human,' the 'natural' and their legal relevance (as well as the resilience of their respective past conceptions even in contemporary law) must be rethought with reference to outer space. This rethinking effort, however, cannot be rooted in or elaborated from a single cultural perspective. The very idea of nature, after all, changes from time to time depending on the culture considered. Not to mention that human nature

[14] On human rights and their transmutations in outer space I refer again to Ricca, *Cultures in Orbit* cit.

itself, even when looking at its biological profile, is a *cultural* nature: and this if only because cultural activity—like language—is an indispensable ingredient in the development of, for example, the human brain and the parts of it (potentially) that are predisposed for the acquisition of the language function. The invention of the semantics of outer space and, consequently, the reinvention of 'nature' and the idea of 'human' will have to be accompanied by an intercultural approach to law. An approach, to put it roughly, in which 'being' and 'ought' will inevitably end up flowing into each other, and this precisely in defining the assumptions of what human beings will be 'free do to' or should do according to law (but also ethics, morality, religion and all deontic systems or perspectives).

I have referenced Article 542 only because it acutely illustrates the pace of the shift in anthropological and legal perspectives between the early 19th century European mindset and the articulation of human cognitive capabilities required by outer space experience.

To conclude with property, I could not help but ask the reader to reflect on the famous definition in Article 544 of the Code Napoléon. The expression 'enjoy and dispose of things in the most absolute way' applied to 'things of space' sounds almost ridiculous. The misery of human presumption inherent in any attempt to translate/transplant this article or, in some way, its normative content would be striking. The *earthly relativeness of absoluteness* that Article 544 implicitly signifies, at least from an anthropological perspective, is dazzling. When one considers that the current controversy over the 'Global Commons' in outer space is primarily concerned with 'property & business rights' (and this, for reasons already stated, reflects a serious lack of perspective), everything seems to take on a connotation oscillating between the untimely and the grotesque.[15]

[15] In this sense, as provocative as it may sound, even the definition of outer space (despite its almost inconceivable immensity but quite absurdly in line with the discourse on 'Global Commons') as part of the 'Common Heritage of Humanity" seems to me to be affected by a pathological anthropocentrism, straddling the tragic and the ridiculous. I fear that unless we are able to engage in a serious exercise of self-criticism, first and foremost epistemological and anthropological, the expression "tragedy of the commons" as applied to human experience in outer space will acquire a different and ironic meaning: as such, very different from that associated with its use in reference to terrestrial ecological constraints and trade-offs. On 'Commons' as 'Heritage of Humanity' see, even with regard to outer space, D. Garcia, *Global Commons Law: Norms to Safeguard the Planet and Humanity's Heritage*, in «International Relations», 35(3), 2021, pp. 422-445. https://doi.org/10.1177/00471178211036027. A critical analysis of the intercultural implication of the idea of 'Common Heritage' and its legal regime is proffered by W. Scholtz, *Common Heritage: Saving the Environment for Humankind or Exploiting Resources in the Name of*

b) Another legal category that would be strongly affected by the absence of gravity is theft. In this case, I would like to move forward to the 20th century and refer to a legal rule from common law countries. More specifically, I would like to focus on the 'Theft Act' of 1968, currently in force in the UK.

> *Theft Act 1968: Definition of "theft"*
>
> 1 Basic definition of theft.
>
> (1) A person is guilty of theft if he dishonestly appropriates property belonging to another with the intention of permanently depriving the other of it; and "thief" and "steal" shall be construed accordingly.
>
> (2) It is immaterial whether the appropriation is made with a view to gain, or is made for the thief's own benefit.
>
> (3) The five following sections of this Act shall have effect as regards the interpretation and operation of this section (and, except as otherwise provided by this Act, shall apply only for purposes of this section).

For the purposes of this essay, section 5 of paragraph 3 of the definition of theft is particularly relevant.

> 5 "Belonging to another."
>
> (1) Property shall be regarded as belonging to any person having possession or control of it, or having in it any proprietary right or interest (not being an equitable interest arising only from an agreement to transfer or grant an interest).

When one imagines applying this regulation of theft to outer space, something quite amazing takes shape, at least in the imagination. I ask the reader to imagine applying this regulation of theft to the experience of astronauts on a space station. I think something potentially very surprising will take shape, at least in their imagination.

For this purpose, let us imagine two astronauts who simultaneously wish to drink water. Suppose, further, that they try to reproduce the same

Eco-Imperialism?, in «The Comparative and International Law Journal of Southern Africa», 41, 2, 2008, pp. 273–93. http://www.jstor.org/stable/23253186. As regard the formula 'tragedy of commons', its 'inventor' Garret Hardin and its critics see G. Harind, *The Tragedy of the Commons*, in «Science» 162 (1968): 1243–1248; E. Ostrom, *Governing the Commons*, Cambridge University Press, New York, 1990; D. Feeny, F. Berkes, B.J. Mccay, et al., *The Tragedy of the Commons: Twenty-two years later*, in «Hum. Ecol.» 18, 1990, pp. 1–19. https://doi.org/10.1007/BF00889070 .

typical situation that is generated on Earth when two neighboring people wish to drink water. Typically, these people will try to pour the water contained in a container into a glass or other receptacle suitable for being brought to the mouth and allowing the liquid to be swallowed. Now, let us try to think of what would happen in space if the two astronauts attempted to adopt the behaviors just described. Since we know that in space there is no gravity, we can imagine that the water poured into the glass will not settle to the bottom. Larger or smaller drops of water will, in all likelihood, begin to *wander* inside the space station. Since water in space is a scarce commodity, it can be assumed to have a conspicuous value. Appropriating another's water, therefore, would constitute much more than embezzlement of things of modest value. In other words, taking another's water to appropriate (namely, drink) it would actually be theft. How to avoid appropriating the water drops originally from the other astronaut—assuming he has possession of them? In this regard, it should be emphasized that Section 5 quoted above speaks of possession or control as the proper 'meaning' of the expression 'property' used in the definition of theft in the 'Theft Act.'

What does 'control' of objects in space mean? What is the proxemic relationship that must occur between things and objects in order to say that someone, through their body, has control over some (inevitably movable) object? Consider, in this regard, that astronauts—as mentioned—have difficulty even being in control of their bodies and their movements at least if compared to what they are capable of doing on Earth. Can the category 'control over moveable items' be considered an anthropological-spatial constant? Does it have a specific legal meaning? Or, conversely, does law presuppose its meaning by implicitly borrowing it from common language (whatever that means)? That is, from the language of the factual world? And is it to this and its variations that law must refer by hetero-integrating its own language and categories, with respect to its experiential and semantic dynamics? In a space full of stray macro-drops of water, how would each astronaut distinguish their own from the other's and try to move with their whole body toward them, stretching out their lips, in an attempt to swallow some? Could anyone really be said to be able to make this distinction? That is, could it be shown that someone *intentionally* wants to take possession of the macro-drop originally of another?[16] Consider that, in this regard, it would make little sense to say that originally the water on the space station is a 'commons.' Theft applies to the material possession/

[16] …and this also because without "the intention to permanently deprive a person of a thing that belongs to her/him and of which s/he has possession or control" there is no theft.

control of something, which can be contingent. It does not have to do with abstract ownership over that thing. The victim of theft can also be the non-owner but mere momentary possessor of a thing.

If one generalizes the example of water, should s/he conclude that in outer space and in the absence of gravity, theft cannot technically take *place*? Or, rather, that we need to radically rethink the anthropological assumptions of proxemics implicit in the definition of theft? Which, *inter alia*, is a category (and thus a crime) that few people in the world would be unwilling to call 'universal' ... thereby falling prey to a serious error of intercultural blindness.[17]

To conclude this section, I would like to make just a brief reference to legal contracts. To the extent that in outer space the relational landscape from which meanings flow changes profoundly, I think that the circuits of intersubjective relations that coincide with the content of contracts would also be affected by this change. To take an example referable to both common law and civil law, the assessment of the lawfulness/unlawfulness of 'consideration' as well as 'contract *basis*' could not avoid being influenced by the changing anthropological-semantic relations produced by the diversity of boundary conditions with respect to life on Earth. The lawfulness of the object of the contractual relationship—whether it refers to the thing or to the whole relationship—cannot be considered independently from its meaning, and this in turn is not independent from the set of semiotic-spatial relations of which it is the epitome, the synthesis. After all, the spatial dimension has always affected the categorization and meaning of contractual activity. When the spatial projection of human activities changes, their meanings also go in tune. This has always occurred throughout history and has not spared contractual practice. Actually, the discovery of the New World produced an extraordinary impact on European contractual experience. It brought about a kind of transplant-translation of canonist principles, stemming from a theological-moral source and concerning the binding nature of so-called naked covenants (i.e., covenants unassisted by the formalities provided by the rules on '*vestimenta*' derived from Roman law) within secular practice.[18] This culminated in Grotius' encyclopedic intellectual effort, proffered in his *De iure belli ac pacis*, and gradually poured into the

[17] In this regard, see M. Ricca, *Ignorantia Facti Excusat: Legal Liability and the Intercultural Significance of Greimas' "Contrat de Véridition"*, in «Int J Semiot Law» 31, 2018, pp. 101–126. https://doi.org/10.1007/s11196-017-9529-6

[18] On this 'transplant', in a huge literature, see W. Decock, *Theologians and Contract Law: The Moral Transformation of the Ius Commune (ca. 1500-1650)*, Martinus Nijhoff, Leiden, 2013.

codifications of modern Europe in the form of a fundamental principle of liberal experience: freedom/autonomy of contract. Therefore, it would not be surprising if the exit into space produced an anthropological-cultural revolution in the conception of the contract and its and practice. The ways and means by which different contractual habits and formal schemes could be reshaped by their projection into outer space are innumerable and I do not intend to unduly dwell on them here. For my purposes, it is sufficient to provide some hints that may stimulate the research and, above all, the imagination of both scholars and non, who—most likely in the person of their descendants—will be the future 'contractors.'

4. *Conclusion: A gaze from without toward "the little threshing floor which makes us so ferocious"*[19]

The brief argumentative journey proposed in the previous pages now allows me to return to the issue of 'Global Commons' as applied to outer space. In this regard, I have to observe that in this case human beings have 'outgrown themselves.' They fight for the 'commons' when they still do not seem to have figured out what they may have in common in their activities in outer space. Their warlike spirit precedes even actual experience. They fight over a 'space' in which they have not yet understood how to 'make space for themselves.' From a certain point of view, it could be said that legal speculation is purely formal, abstract. Personally, I see things very differently. Speculating on property, on business activities, in outer space, is extremely concrete, even too much so. Unfortunately, it is a 'misplaced' activity. It is spurred more by greed and competition than by any genuine need or desire for knowledge. The main driver seems to be an anxiety to grab space and its 'utility' and steer them to 'territorialize' outer space, making it a projection of their life on Earth. Anthropological blindness, pragmatic ignorance and political calculation do the rest. As is the case with the race to the Moon many years ago, the main interest seems to lie not in celestial objects but rather in their indirect relevance for the political-competitive dynamics consumed on Earth. If this is the real situation, however, the controversy over the 'Global Commons' in outer space seems to be reduced mainly to a

[19] The expression 'the little threshing floor which make us so ferocious' is borrowed from Dante's Divine Comedy, Paradise, 22.51, translated by A.S. Kline. Available at: https://www.poetryintranslation.com/PITBR/Italian/DantPar22to28.php

syndrome of alienation. The 'extra-terrestrial' human beings are still taking their first steps. Basically, they do not know who they are. Discussions about those who will be able to make practical use of the resources of celestial bodies concern 'human beings' who do not yet exist.

Not all of these controversies are useless, however. Despite their current defectiveness, they can still highlight the need for a thorough anthropological analysis of human beings in the absence of Earth boundary conditions. As with experiments that are carried out in outer space in chemistry, physics, medicine, and so on, changing boundary conditions can give a better understanding of what is happening on Earth. And this is precisely because absence can turn many constants into variables, stimulating new questions and, with them, the possibility of understanding human beings, as well as the world that surrounds them and contributes to shaping their life.

From a critical perspective, the first lesson this controversy gives human beings is the ability to see their own aggressiveness from the outside. Almost as if in a game of mirrors, discovering the futility and abstract self-referentiality of the discussion of 'global commons' applied to outer space can give us a glimpse of the same futility and self-destructiveness of any discussion stimulated by the longing for territorialization that has affected and infected human beings since the dawn of their adventure on the planet. There is a long literary history of the multiple attempts made by a few intellectual heroes to look at themselves from outside, from outer space.[20] One of them, to my way of thinking of extraordinary effectiveness, is accomplished by Dante Alighieri. In canto XII of Paradise, when he is about to leave Beatrice to enter the eighth heaven where she is not allowed to enter, Dante narrates that he has rotated together with the constellation Gemini. From that position, the poet says, 'the little threshing-floor that makes us so ferocious, all appeared to me from the mountains to the river-mouths.'

In my opinion, Dante and other authors who tried to imaginatively place themselves outside earthly boundaries to critically observe humanity and themselves in an attempt to wriggle free from the psychological and cognitive constraints of earthly experience are true ethical heroes. Today human beings have the opportunity to make in fact the journey that those authors dared to make in imagination. It is an extraordinary opportunity that human beings have given to themselves. That they run up against the fatal error of 'looking at space from a merely terrestrial perspective,' radicalizing instead of relativizing the cultural limits of their experience within the confines of the atmosphere, is truly disheartening.

[20] D. Cosgrove, *Apollo's Eye: A Cartographic Genealogy of the Earth in the Western Imagination*. John Hopkins University Press, Baltimore, 2001.

What is worse, from my perspective, is that human beings use law, legal discourse, to try to construct and secure in advance advantages, gains, utilities, pertaining to a dimension of experience that they do not yet know in its practical, anthropological, biological, psychological, axiological and semiotic import. Outer space is still little more than a sign. To be more explicit, it is a sign that is almost entirely yet to be interpreted and whose meaning can only be discovered by means of an enactively-prospective and retrospective self-interpretation of the human in relation to its experience within it. The axiological and legal imagination is one of the sextants we can use in an attempt to plumb these "unknown extraterrestrial domains" and interpenetrate them in transformative ways. In this direction, law and its words are to be understood as means of forwarding into a new 'space of experience.' Legal categories will thus have to be read not so much as aprioristically determined schemes to be applied and superimposed onto facts but rather as 'semiotic orientation devices'—as such necessarily connoted by semantic entropy—to adapt to an environment that changes along with our attempts to adapt to it. Understanding how to invent ways of adapting to outer space will simultaneously and constantly mean re-inventing law. It is so because humankind will be able to determine the 'factual' meaning of outer space in human experience, and vice versa, only by selecting how to behave out there. What we do not do, simply will not happen. Of course, the coincidence between what we decide we must make happen and what will actually happen will remain only infinitely asymptotic. Nonetheless, the misunderstanding of the anthropologically co-generative relationship extant between the dimension of extraterrestrial facts that is as yet unknown, on the one hand, and the discursive universe of values and legal rules, on the other, would doom those humans who dare to venture into the inhospitable immensity of outer space to catastrophe.

The debate over 'commons' in outer space is a real adventure for human discovery and, therefore, also the meaning of law and (human) rights. Rules about the 'commons,' in outer space more than elsewhere, require a preliminary understanding of what is 'common.' In turn, understanding what is common to human beings requires that human beings 'create themselves' and their own space in 'cosmic space.'[21]

[21] In a literature that is growing by the day, I would like to point out, in this regard, three readings that seem to me to be useful for future research by those who intend to address the topic discussed in this article: L. Codignola, K. Schrogl et al. (eds.), *Humans in Outer Space - Interdisciplinary Odysseys*, Springer, Wien - New York, 2009; J.S.J. Schwartz, T. Milligan, (eds.), *The Ethics of Space Exploration*, Springer, Switzerland, 2016; F. Salazar, A. Gorman, (eds.), *The Routledge Handbook of Social Studies of Outer Space*, Routledge, Abingdon, Oxon, 2023.

ROMA TRE
UNIVERSITÀ DEGLI STUDI

After decades of exceptional development of the digital sector, we are witnessing a renewed interest of public and private entities in outer space, with the simultaneous presence of national defense and geopolitical strategic interests and new business interests aiming to profit. Technological evolution and the consequent growing role of space economy require, at all the domestic and international levels, more detailed and certain legal rules. Selected contributions from the conference "Comparative Visions in Space Law" have been collected in this book, reflecting the cross-boundary approach which characterized the event: dialogue among a multitude of disciplines and legal experiences, shaping new horizons of collaboration which are indispensable to understand the economic, geopolitical, diplomatic stakes of space law, and its technical aspects and difficulties.

Sirio Zolea is senior researcher of Private Comparative Law at the Law Department of Roma Tre University, where he teaches "Space Policies and the Law" and "European and Comparative Data Law". His research is focused on comparison in the field of law and technology.

RomaTrE-Press
2024