Widening the horizons of outer space law

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E.M. MEIJERS INSTITUUT
INSTITUUT VOOR RECHTSWETENSCHAPPELIJK ONDERZOEK

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T.L. MASSON-ZWAAN

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Two things fill the mind …: the starry heavens above me
and the moral law within me.

– Immanuel Kant

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PROEFSCHRIFT

ter verkrijging van
de graad van doctor aan de Universiteit Leiden,
op gezag van rector magnificus prof.dr.ir. H. Bijl,
volgens besluit van het college voor promoties
te verdedigen op donderdag 9 februari 2023
klokke 16.15 uur

door

Tanja Louise Masson-Zwaan

geboren te Rotterdam

in 1961

Promotor: prof. dr. P.M.J. Mendes de Leon

Promotiecommissie: prof. dr. S.J. Truxal
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prof. dr. A. Masutti (University of Bologna, Italy)
prof. dr. I.B.R. Supancana (Catholic University of Atma Jaya, Indonesia)
prof. dr. M. Hofmann (University of Luxembourg, Luxembourg)

Lay-out: AlphaZet prepress, Bodegraven
Printwerk: Ipskamp Printing

ISBN 978-94-6421-977-7

Acknowledgements

This dissertation is long overdue. I started writing my first thesis proposal at the beginning of my career in the late 1980s at the International Institute of Air and Space Law at Leiden Law School of Leiden University at the instigation of Professor Or Wassenbergh, my earliest mentor in the field of space law. I will never forget those fun and inspiring years. Rather than being preoccupied with PhD research, I was too busy finding my way in the field and was drawn to other projects such as organising an air and space law conference in Mexico with my colleague, friend and now promotor prof. Pablo Mendes de Leon, or editing a book with young space law authors from over the world with my friends Walter de Vries, Harry Tuinder and Ilias Kuskuvelis, Space Law: Views of the Future.

And then, after five years, as it goes, life happened. I moved to France with my husband, our three sons were born there, and after six years we moved to Singapore, where we also stayed six years and our daughter was born. After about two more years back in France we came back to the Netherlands, and in 2008 I moved back into my former job at the Institute, re-joining forces with Pablo. In all those years abroad, I had developed a career and reputation in space law, culminating in becoming President of the International Institute of Space Law (IISL) in 2007. During my twenty-five years on the board of IISL I was supported by several space law icons who believed in me and made me who I am today. Prof. Isa Diederiks Verschoor and Eilene Galloway deserve special mention in that context. I always try to follow their example in guiding the new generation of space lawyers.

Being an accomplished expert in my field by now, I did not really feel the need to write a PhD thesis, and I was busy with my responsibility for the space law teaching in our LLM program, publishing, and consulting work. I owe it to Pablo who has continuously pushed me – gently – and convinced me that it is worth it, even towards the end of my career, to fulfil the requirements of a PhD degree. Having published extensively on a variety of topics, the solution of publishing a combination of articles offered by Leiden Law School helped greatly.

The collegial spirit that always reigned at the Institute, its staff, students and alumni is exceptional, and has resulted in a worldwide network of friends and colleagues. I thank all current and former colleagues, students and alumni for their inspiration, collegiality and friendship.

My late parents would have been so proud to see me reach this point. The bonds we had as a family have helped me shape my own family to their example, in an atmosphere of love, trust, respect and support. Especially my father, who was a surgeon and had nearly obtained his PhD early in his career but then gave up, for much the same reasons as I nearly did, would have been thrilled to share this moment with me. Having cared for our parents extensively in the last years of their lives, my brother Tom, sister Helen and I grew closer, and I cherish our times together at the family hideaway in Cadzand that our parents left us.

A few years ago, our son Louis defended his PhD in robotics in Lausanne. We had been in a friendly race, which he won, and I am proud of him – and of me for having caught up. I am also thankful for Nicolas, Laurent and Emilie, who are each on their own professional and personal journeys and who fill me with great love and pride for being beautiful global citizens. Jacques, my buddy and life partner through good times, and some difficult ones, thank you for always making me laugh and for showing me that things are not always as complicated as I tend to make them. We are a perfect combination of rationality and passion and I love what we built together. I look forward to continuing our journey and our shared passion for space.

Space unites, inspires and allows humankind to move forward and upward. Discoveries of our universe, advances in technology, and the improvement of life on Earth through space applications will continue to motivate me in contributing to a transparent and inclusive legal framework, together with all the friends and colleagues who have become part of my extended space law family over the years.

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List of Principal Acronyms and Abbreviations

AAS	American Astronomical Society
ADR	Active Debris Removal
ARRA	Rescue and Return Agreement
ATM	Air Traffic Management
CCSDS	Consultative Committee for Space Data Systems
CD	Conference on Disarmament
CHM	Common Heritage of Mankind
COPUOS	Committee on the Peaceful Uses of Outer Space (UN)
COSPAR	Committee on Space Research
COVID-19	Severe Acute Respiratory Syndrome Coronavirus 2
CRP	Conference Room Paper (UN)
CSpOC	Combined Space Operations Center (USA)
EAS	European Astronomical Society
EC	European Commission
EEZ	Exclusive Economic Zone
EPFL	Ecole Polytechnique Fédérale de Lausanne
ESA	European Space Agency
EU	European Union
FAA	Federal Aviation Administration (USA)
FCC	Federal Communications Commission (USA)
GEO	Geostationary Orbit
GNSS	Global Navigation Satellite System
GPS	Global Positioning System (USA)
GSO	Geostationary Satellite Orbit
IAA	International Academy of Astronautics
IADC	Inter-Agency Debris Coordination Committee
IAF	International Astronautical Federation
IAU	International Astronomical Union
ICAO	International Civil Aviation Organization
ICJ	International Court of Justice
IGA	Intergovernmental Agreement (ISS)
IIASL	International Institute of Air and Space Law (Leiden Law School)
IISL	International Institute of Space Law
ILA	International Law Association
ISO	International Organisation for Standardisation
ISS	International Space Station
ITAR	International Traffic in Arms Regulations (USA)
ITU	International Telecommunication Union
LEO	Low Earth Orbit

LIAB	Liability Convention
LSC	Legal Subcommittee (UNCOPUOS)
LTS	Long-term sustainability
LTSSA	Long-term sustainability of space activities
MIFR	Master International Frequency Register (ITU)
MOON	Moon Agreement
NASA	National Aeronautics and Space Administration (USA)
NEPA	National Environmental Policy Act (USA)
OOS	On-orbit servicing
OOSA	Office for Outer Space Affairs (UN)
OST	Outer Space Treaty
PAROS	Prevention of an Arms Race in Outer Space
REG	Registration Convention
Res.	Resolution (UN)
SARPs	Standards and Recommended Practices (ICAO)
SDA	Space Data Association
SDG	Sustainable Development Goals (UN)
SSA	Space Situational Awareness
SSC	Space Safety Coalition
SSR	Space Sustainability Rating
SST	Space Surveillance and Tracking
STM	Space Traffic Management
STSC	Scientific and Technical Subcommittee (UNCOPUOS)
SWF	Secure World Foundation
TFEU	Treaty on the Functioning of the European Union
UAE	United Arab Emirates
UK	United Kingdom
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNCOPUOS	United Nations Committee on the Peaceful Uses of Outer Space
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNGA	United Nations General Assembly
UNOOSA	United Nations Office for Outer Space Affairs
UNTS	United Nations Treaty Series
US(A)	United States (of America)
USSR	Union of Soviet Socialist Republics
VCLT	Vienna Convention on the Law of Treaties
WEF	World Economic Forum

I Introduction

This introduction explains the context of the study and sets the scene for the content that follows. It highlights the changes that occurred in the landscape of space activities over the roughly half century of its existence and mentions the implications of these changes. This setting of the scene leads to the formulation of the central research question of this research, which is further divided into three sub-questions. Each of them is briefly addressed in section 2 of this Introduction. The methodology and an explanation of the structure of the study are addressed in section 3.

1 Research Context

Shortly after the start of the space age, with the launch of Sputnik 1 by the former Union of Soviet Socialist Republics (USSR) on 4 October 1957, States convened within the United Nations (UN) to discuss ways and means to govern the activities of States in that next frontier for humanity. Their main concern at the time was to maintain outer space for peaceful purposes and to avoid a weapons race in outer space, resulting in a strong political will to reach agreement on principles of behaviour. In this vein, the Outer Space Treaty of 1967,[1] the first of five international space treaties adopted by the

1 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, adopted 19 Dec. 1966, entered into force 10 Oct. 1967, 610 UNTS 205 (hereafter Outer Space Treaty). The subsequent treaties are: the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, adopted 19 Dec. 1967, entered into force 3 Dec. 1968, 672 UNTS 179 (hereafter Rescue and Return Agreement), the Convention on International Liability for Damage Caused by Space Objects, adopted 29 Nov. 1971, entered into force 1 Sept. 1972 (hereafter Liability Convention); the Convention on Registration of Objects Launched into Outer Space, adopted 12 Nov. 1974, entered into force 15 Sept. 1976, 1023 UNTS 15 (hereafter Registration Convention); and the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, adopted 5 Dec. 1979, entered into force 11 July 1984, 1363 UNTS 3 (hereafter Moon Agreement). For the status of ratification of the five treaties, see *Status of International Agreements relating to activities in outer space as at 1 January 2022*, UN Doc A/AC.105/C.2/2022/CRP.10 (28 March 2022).

UN Committee on the Peaceful Uses of Outer Space (COPUOS),[2] can be considered a peacekeeping treaty.[3]

In less than sixty years, that next frontier has been conquered in more than one way. Twelve men have left Earth to set foot on another celestial body, our Moon.[4] Hundreds of persons have travelled to outer space; professional astronauts from many nationalities have lived and worked on the International Space Station (ISS), about 400 kilometres above the Earth's surface, without interruption since 2000.[5] Commercial astronauts have also joined the ranks of those who have left the Earth's atmosphere.[6] Uncrewed exploration missions to celestial bodies within and beyond our solar system have been carried out, discoveries have been made of far-away galaxies, and in 2022 the first ever image of the supermassive black hole at the centre of the Milky Way was revealed.[7] Closer to our planet Earth, space applications such as remote sensing by satellite, satellite communication and satellite navigation and positioning have produced immense benefits for humankind across the globe. A day without satellites is no longer imaginable, or even feasible.[8]

Besides creating benefits, space activities also pose challenges. Rapid technological developments and entrepreneurial initiatives challenge the suitability of the legal framework that was agreed in the 1960's and 1970's to govern the activities of a handful of States. The increase of both State-

2 COPUOS was set up by the UN General Assembly in 1959 to govern the exploration and use of space for the benefit of all humanity, for peace, security and development. It has two subsidiary bodies, the Scientific and Technical Subcommittee, and the Legal Subcommittee, see https://www.unoosa.org/oosa/en/ourwork/copuos/index.html (accessed in August 2022).

3 This is also illustrated by the fact that the chapter on space law in *The Oxford Handbook of United Nations Treaties* was placed in a section addressing 'International Peace and Security'; Tanja Masson-Zwaan & Roberto Cassar, 'The Peaceful Uses of Outer Space', in Simon Chesterman, David M. Malone and Santiago Villalpando (eds.), *The Oxford Handbook of United Nations Treaties* (2019), pp. 181-198 (included as ch. II in this present study).

4 See an overview at https://solarsystem.nasa.gov/news/890/who-has-walked-on-the-moon/ (accessed in August 2022).

5 For an overview of the ISS, see e.g., the website of ESA, https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/International_Space_Station, or NASA, https://www.nasa.gov/mission_pages/station/main/index.html. For an overview of visitors since 2000, see NASA, *Visitors to the Station by country*, https://www.nasa.gov/feature/visitors-to-the-station-by-country/ (all accessed in August 2022).

6 See https://www.faa.gov/space/human_spaceflight/recognition/ (accessed in August 2022).

7 See *First photo of black hole at the heart of our Galaxy*, Leiden University, https://www.universiteitleiden.nl/en/news/2022/05/first-photo-of-black-hole-at-the-heart-of-our-galaxy. For a good overview of the benefits of space exploration, see UN Office for Outer Space Affairs (UNOOSA), *Benefits of space for humankind*, https://www.unoosa.org/oosa/en/benefits-of-space/benefits.html (accessed in August 2022).

8 See *A new animation shows 'A day without space'*, DLR, https://www.dlr.de/content/en/articles/news/2021/02/20210611_a-new-animation-shows-a-day-without-space.html (accessed in August 2022).

and non-State actors and of satellites, especially in Low Earth Orbit (LEO), makes outer space increasingly contested and congested, to the point that the long-term sustainability of space activities is at stake.[9] The advent of private entities and commercial space applications can generate benefits for humanity, but will also bring challenges, such as environmental concerns, congestion, or the lack of proper regulation and oversight. Private actors are here to stay, and in the future their plans will increasingly put States' ability to regulate their activities to the test. The first unauthorised private space activities have already occurred,[10] and interference between different users, including clashes between commercial and publicly funded ones, will only grow. The risk of collisions, especially in LEO, increases significantly with the launch of thousands of small satellites by private entities. In the absence of a space traffic management regime, this gives rise to considerable challenges to the long-term sustainability of space activities.

There is also good news. The injection of private capital and entrepreneurial spirit can bring significant opportunities in innovation and creativity which can be of great benefit to humanity on the condition that a clear, equitable and predictable legal framework exists. Such innovative projects include the commercial use of space resources, the operation of commercial space stations, or suborbital flights. These initiatives can be criticised as serving as a playground for billionaire entrepreneurs and damaging the environment,[11] and there is certainly a level of truth in those critiques. But it cannot be denied that these same billionaires are the ones who are democratising access to space by miniaturising and standardising satellites, are revolutionising the launch industry by making rockets reusable and hence 'greener', are producing and developing the technology for deep space missions and are paving the way for future high speed intercontinental travel between two points on Earth.

The fundamental question is whether the current legal framework for space activities can accommodate these challenges or whether it needs further additions. The present legal framework has without doubt provided a suitable and flexible system for the first decades of space activity, resulting

9 Long-term sustainability of space activities has been defined as follows in the COPUOS Guidelines for the long-term sustainability of space activities of 2019: 'the ability to maintain the conduct of space activities indefinitely into the future in a manner that realizes the objectives of equitable access to the benefits of the exploration and use of outer space for peaceful purposes, in order to meet the needs of the present generations while preserving the outer space environment for future generations', see UN Doc A/74/20, para 163 and Annex II (2019).

10 See e.g., Scarlet Wagner, Bees in space - Swarm Technologies' unauthorised deployment of SmallSats and Art. VI of the Outer Space Treaty', in P.J. Blount et al. (eds.), *2018 Proceedings of the International Institute of Space Law* (Eleven Publishing, 2019), p. 129-142, and Chris Johnson et al., 'The curious case of the transgressing tardigrades (part 1)', *The Space Review*, 26 August 2019, https://www.thespacereview.com/article/3783/1 (accessed in August 2022).

11 See e.g., Roxanne Roberts, 'Billionaires in space: The launch of a dream or just out-of-this-world ego?', *Washington Post*, 18 July 2021.

in peaceful cooperation and the avoidance of a weapons race in space. However, the inability to conclude new legally binding agreements ('hard law') since the adoption of the 1979 Moon Agreement has led to the formulation of new principles in non-legally binding instruments in the form of UN resolutions and sets of guidelines ('soft law').

Although the concept of 'soft law' is not recognised by all and one could argue that law is either 'hard', i.e., legally binding, or non-existing,[12] it is considered relevant in several fields by eminent scholars.[13] Admittedly, 'soft law' is not listed among the formal sources of international law[14] and the ultimate goal should always be the conclusion of a legally binding instrument, but the relevance of soft law cannot be underestimated, especially in the absence of consensus on new legally binding instruments, and its legal effect is not null and void. As Boyle observes:

> 'From a law-making perspective the term 'soft law' is in most cases simply a convenient description for a variety of non-legally binding instruments used in contemporary international relations by States and international organizations. Soft law in this sense can be contrasted with hard law, which is always binding. Non-binding soft law instruments are not law per se, but may be evidence of existing law, or formative of the *opinio juris* or State practice that generates new customary law. They may additionally acquire binding legal character as elements of a treaty-based regulatory regime, or constitute a subsequent agreement between the parties regarding interpretation of a treaty or application of its provisions. Other non-binding soft-law instruments are significant mainly because they are the first step in a process eventually leading to conclusion of a multilateral treaty, or because they provide the detailed rules and technical standards required for the implementation of a treaty. An alternative view of soft law focuses on the contrast between 'rules' , involving clear and reasonably specific commitments which are in this sense hard law, and 'norms' or 'principles',

12 Dupuy describes soft law as 'a paradoxical term for defining an ambiguous phenomenon', Pierre-Marie Dupuy, 'Soft law and the international law of the environment', *Michigan Journal of International Law* 12(2) (1991), at p. 420.

13 E.g., in the context of sustainability, Schrijver observed that 'the concept of sustainable development was really launched through so-called soft law in the period of the United Nations', and that, '[a]part from consolidating and codifying sustainable development in treaty law, soft law is instrumental in further clarifying and progressively developing the scope and meaning of sustainable development', Nico Schrijver, '2019 AIIB Law Lecture: The rise of sustainable development in international investment law', in Peter Quayle (ed.), *The role of international administrative law at international organizations, AIIB Yearbook of International Law* (2020), p. 297-323, at p. 299-300.

14 Art. 38 of the Statute of the International Court of Justice (1945) lists international conventions, international custom and general principles of law recognized by civilized nations as the main sources, and judicial decisions and the teachings of the most highly qualified publicists of the various nations as subsidiary means for the determination of rules of law. See also Nico Schrijver, *Internationaal publiekrecht als wereldrecht* (Public International Law as World Law), (2020), ch. 3, *Bronnen van het internationale publiekrecht* (Sources of public international law), p. 51-62, and Anthea Roberts & Sandesh Sivakumaran, 'The theory and reality of the sources of international law', in Malcolm D. Evans (ed.), *International Law*, (5_{th} ed., 2018), p. 89-118.

> which, being more open-textured or general in their content and wording, can thus be seen as soft even when contained in a binding treaty. It is a fallacy to dismiss soft law because it does not readily fit a theory of what is 'law': properly understood, it can and does contribute to the corpus of international law-making.'[15]

Even though the entry into force of new treaties, as well as their effective implementation, remains the preferred method of space law-making, this author believes that the combination of 'hard' and 'soft' space law, consisting of treaties, resolutions and sets of guidelines, provides a flexible and mostly satisfactory legal framework, which can be implemented through national law and hence become binding upon private space actors.[16] In other words, the progressive development of space law in the form of soft law is not a major issue.

But the current framework of hard and soft law does present certain challenges. There is a lack of clarity and definitions in the UN space treaties, e.g., the legal status of inactive objects and debris needs to be clarified; it is unclear if the term 'space object' includes pieces of space debris that are no longer active, which could have serious implications for the potential liability of launching States for damage caused by debris.[17] Moreover, there is no prescribed standard of fault to determine the liability of launching States in case of damage occurring in outer space caused by its space object to a space object of another launching State or to persons or property on board such a space object.[18] It is also unclear whether 'damage' includes indirect damage, environmental damage, or economic losses.[19] There is no clear obligation to conduct space activities in a sustainable manner besides generic provisions on due regard and the avoidance of harmful

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15 Alan Boyle, 'Soft law in international law-making', in Evans, *supra* n. 14, p. 119-137. See also by the same author, 'The choice of treaty: hard law versus soft law', in Chesterman *et al., The Oxford Handbook of United Nations Treaties*, *supra* n. 3, p. 102-117. On the legal value of UN resolutions as instruments of 'soft law', see *Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion*, ICJ Reports 1996, p. 226: 'General Assembly resolutions, even if they are not binding, may sometimes have normative value. They can, in certain circumstances, provide evidence important for establishing the existence of a rule or the emergence of an *opinio juris*.' (para. 70).

16 On 'soft law' in the context of space law, see Setsuko Aoki, 'The Function of "Soft Law" in the Development of International Space Law' in Irmgard Marboe (ed.), *Soft Law in Outer Space: The Function of Non-Binding Norms in International Space Law* (2012), p. 58. See also Cheng, who introduced the concept of 'instant' custom, Bin Cheng, 'United Nations Resolutions on Outer Space: 'Instant' International Customary Law?', *Studies in International Space Law* (1997) at p. 125.

17 The term 'space object' is vaguely defined in two of the UN space treaties as follows: 'The term 'space object' includes component parts of a space object as well as its launch vehicle and parts thereof'. See art. I(d) of the Liability Convention and art. I(b) of the Registration Convention.

18 Art. III of the Liability Convention. In this study, only civil liability is addressed; tort liability does not fall within the scope of the research.

19 Id., Art. XII.

contamination.[20] The duty to register objects launched into outer space is interpreted differently by States in terms of timing or the level of detail to be provided.[21] Likewise, in the ongoing climate of geopolitical tensions characterised by the creation of 'space forces' by several States,[22] and the testing of anti-satellite technology and cyber threats against space infrastructure,[23] the legality of the use of outer space for military purposes could benefit from clarification beyond the mere prohibition of nuclear weapons and weapons of mass destruction and the obligation to use celestial bodies for exclusively peaceful purposes.[24]

And, not unimportantly, more clarity is needed about how private actors fit in the State-centred framework and how their interests can be met. The lack of precise definitions and specific details in the treaties carry the risk of stifling innovation because private entities may be reluctant to invest in new technology and commit the substantial funding this requires without legal certainty. The new context of increased private space activities also means that the role of national regulatory frameworks becomes increasingly relevant. Several States have enacted national legislation to implement their duty of regulatory oversight, and they need to address the challenges described above. As mandated by Article VI of the 1967 Outer Space Treaty, States must authorise and continuously supervise the space activities carried out by their national entities. They can do so by diverse methods and means, such as by implementing national law. These national laws will require continuous updating to comply with additional guidelines and standards that may be agreed at the international level, and their robustness will have to be regularly assessed in view of rapidly emerging innovative plans and activities.

It is this need for a constant balancing between threats and opportunities, bringing to light the strengths as well as the weaknesses of the current legal framework for space activities, that serves as the central theme for this study. Progress cannot be stopped, but it requires a comprehensive, clear, equitable and flexible legal framework that meets the interests of all stakeholders while safeguarding the continued use of outer space into the future. A way must be found to ensure the continued availability of a safe, secure and sustainable environment in outer space for current and future generations.

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20 Art. IX of the Outer Space Treaty.

21 Art. IV of the Registration Convention.

22 The US Space Force was established in 2019, https://www.spaceforce.mil/; the French *Commandement de l'Espace* in 2019, https://www.legifrance.gouv.fr/loda/id/LEGITEXT000039062984/, the Japanese Space Operations Squadron in 2020, https://www.mod.go.jp/en/jdf/no125/specialfeature.html and the UK Space Command in 2021, https://www.raf.mod.uk/what-we-do/uk-space-command/ (all accessed in August 2022).

23 Secure World Foundation, *Infographic on Anti-Satellite Weapons and Space Sustainability*, 7 June 2022, https://swfound.org/news/all-news/2022/06/swf-releases-new-infographic-on-anti-satellite-weapons-and-space-sustainability/ (accessed in August 2022).

24 Art. IV of the Outer Space Treaty.

2 Research Questions

Considering the context described above, the central research question of this study is the following:

> *Does the existing international legal framework for space activities adequately regulate the current and future challenges opportunities of the use, exploration and exploitation of outer space, and if not, how can this be remedied?*

That central question is divided into three sub-questions. The first sub-question is whether the existing international legal framework for space activities adequately regulates the *current and future challenges* of the use, exploration and exploitation of outer space. This question is relevant for both States and non-State actors. An analysis of the United Nations space treaties is needed to assess whether they can adequately regulate the evolving landscape of space activities which is characterised by a growing number of private actors, and whether they provide an adequate framework to address contemporary issues, such as the proliferation of space debris. The *future* challenges arising from the use, exploration and exploitation of outer space include the need for a Space Traffic Management regime to provide standards and 'rules of the road' to ensure safety, sustainability and security. They also include the need to accommodate a growing number of stakeholders with legitimate interests, by balancing and protecting the interests of scientific as well as commercial users. These questions are addressed in *chapters II – VI* which constitute Part A of the research, titled 'The Legal Framework for Space Activities: Current and Future Challenges'.

The second sub-question turns to the future and explores whether the existing international legal framework for space activities adequately regulates the *future opportunities* of the use, exploration and exploitation of outer space. Here, the research shows that it will be difficult to accommodate the increasing private commercial innovative uses of space, such as the use of space resources or commercial human spaceflight, in the existing legal framework. The research therefore focuses on how this framework can be improved by complementing it with new international hard or soft law, national law, or multi- or minilateral or regional agreements. This question is addressed in *chapters VII-X* and forms Part B of this research, titled 'The Legal Framework for Space Activities: Future Opportunities'.

The importance of national space legislation to implement treaty obligations is growing alongside the increase of private commercial space activities. The third and last sub-question therefore investigates the situation at the national level and takes The Netherlands, a small but ambitious space State with a flexible yet comprehensive legal framework, as example. *Chapters XI-XIII* of the study form Part C, titled 'The Legal Framework for Space Activities: The Netherlands', and review the robustness of *The Netherlands'* legal framework in light of the existing legal framework for space activities and the current and future challenges and opportunities of the use, exploration and exploitation of outer space.

In summary, the three sub-questions are as follows:

a) Does the existing international legal framework for space activities adequately regulate the *current and future challenges* of the use, exploration and exploitation of outer space and if not, how can this be remedied?
b) Does the existing international legal framework for space activities adequately regulate the *future opportunities* of the use, exploration and exploitation of outer space and if not, how can this be remedied?
c) Is *The Netherlands*' legal framework adequate, in light of the existing legal framework for space activities and the current and future challenges and opportunities of the use, exploration and exploitation of outer space and if not, how can this be remedied?

Answers to these sub-questions will be summarised in the concluding part, titled 'A View of the Future'. In this part, views expressed in the 1988 book 'Space Law: Views of the Future', which the author edited and published in the early years of her academic career, will be revisited to observe elements of convergence or diversion.[25]

The following sub-sections of this Introduction briefly elaborate on each sub-question, whereas section 3.2 provides a more detailed overview of the content of each chapter.

2.1 The Legal Framework for Space Activities: Current and Future Challenges

The research contained in *chapter II* shows that the legal framework has grown within a specific geopolitical context and contains a set of basic principles that States must adhere to when using and exploring outer space. The chapter explains the background, history and main principles of the UN space treaties and argues that it is not likely that new treaties will be adopted anytime soon. Soft law is the most likely way forward,[26] in the form of UN resolutions and sets of guidelines, for instance in the field of debris mitigation and the long-term sustainability of space activities.[27] The legal challenges posed by space debris and long-term sustainability are addressed in *chapters III and IV*, respectively.

Further challenges will occur in the mid- to longer term. STM is a prime example, as is the growing potential of incompatibility between

25 Tanja L. Zwaan, Walter W.C. de Vries, Paul Henry Tuinder and Ilias I. Kuskuvelis (eds.), *Space law: views of the future* (Kluwer, 1988).

26 See the sources mentioned in n. 13-15, *supra*.

27 Space Debris Mitigation Guidelines, endorsed by COPUOS at its 50_{th} session and contained in UN Doc A/62/20, annex, and endorsed by the UN General Assembly in its resolution 62/217 of 22 Dec. 2007; Guidelines for the Long-term Sustainability of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space, UN Doc A/74/20, para 163 and Annex II (2019).

several legitimate uses of outer space, such as the disturbance of astronomical observations by large satellite constellations. The concept of STM is addressed in *chapter V*. This topic has been climbing on the agendas at international,[28] regional (EU)[29] and national[30] level, especially since the proliferation of hundreds if not thousands of satellites in LEO with the advent of large constellations of satellites planned, launched and operated by companies like SpaceX, OneWeb or Amazon.[31] A comparison with air transport and maritime transportation shows that the adoption of traffic rules enhances safety, but may also benefit security and sustainability. The absence of traffic rules will soon become a real problem because of increasing congestion in LEO, and rules of the road, guidelines for decommissioning of satellites at the end of their useful life and increased tracking capability are dearly needed. Even the industry itself is convinced of the need for STM, as can be seen from several bottom-up initiatives like the Net Zero Space Declaration or the Space Sustainability Rating.[32]

The phenomenon of large satellite constellations is bringing another emerging problem to light, which is discussed in *chapter VI* of this study. Since there will be numerous objects in space, operated by an ever-larger group of operators with varying levels of experience and expertise, the chances of one group of users interfering with another group increases significantly. The example of the astronomical community ringing the alarm bell as optical observations are increasingly disrupted by the simultaneous launch of over sixty satellites at a time for SpaceX's Starlink constellation demonstrates that the needs of different stakeholders must be coordinated, and measures must be taken to minimise such disturbance. Here as well, discussions take place at multiple levels and there is a growing awareness of the problem and potential solutions. [33]

These examples of challenges that will arise in the mid- to longer term provide additional illustration of the fact that the present legal framework for space activities is stretched almost to the breaking point and needs to be equipped with additional tools.

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28 The topic 'General exchange of views on the legal aspects of space traffic management' was added on the agenda of the COPUOS Legal Subcommittee in 2016.

29 European Commission and High Representative of the Union for Foreign Affairs and Security Policy, *Joint Communication to the European Parliament and the Council, An EU Approach for Space Traffic Management*, JOIN (2022) 4 final, 15 Feb. 2022.

30 See, e.g., US Space Policy Directive-3, *National Space Traffic Management Policy*, 18 June 2018.

31 See, e.g., Aaron C. Boley & Michael Byers, 'Satellite mega-constellations create risks in Low Earth Orbit, the atmosphere and on Earth', *Nature*, Sci. Rep. 11, 10642 (2021), https://doi.org/10.1038/s41598-021-89909-7 (accessed in August 2022).

32 See https://parispeaceforum.org/en/initiatives/net-zero-space/ and https://www.weforum.org/projects/space-sustainability-rating, respectively (both accessed in August 2022).

33 See e.g., Giuliana Rotola and Andrew Williams, 'Regulatory Context of Conflicting Uses of Outer Space: Astronomy and Satellite Constellations', 46 *Air and Space Law* (2021), pp. 545 – 568.

2.2 The Legal Framework for Space Activities: Future Opportunities

The new space era also presents opportunities; new developments and technologies that will enable humankind to explore ever further and to benefit even more from the use of outer space. But those opportunities will also have to be accompanied by a legal framework that is able to safeguard and balance the interests of all stakeholders while ensuring sustainability and the equitable sharing of benefits.

The prospect of the commercial use of space resources has drawn considerable attention in the space law community, as it brings fundamental questions regarding the interpretation of the UN space treaties to the forefront and raises the need to provide adequate regulation of this activity. This topic is the subject of *chapters VII and VIII*. Pioneering enterprises with plans to extract, process, and sell resources on the Moon and asteroids have come and gone. Technologies are still being developed, but there is no doubt that this new activity will see the light of day. Various States decided to take a unilateral step forward by adopting national laws that explicitly allow private entities to own such resources.[34] This step was met by criticism in COPUOS, where several delegations were of the view that any interpretation about the legality of and legal requirements for resource utilisation should be agreed upon internationally. Besides the question whether resources can be owned at all despite the non-appropriation principle enshrined in the Outer Space Treaty, other questions include whether safety zones around mining operations are allowed and, if so, under what conditions, or how the equitable sharing of benefits can be ensured.[35] Progress will be slow, but the creation of a dedicated working group in COPUOS in 2021 is a good sign that consensus might be reached on the minimal requirements that should frame this activity.[36] The future possibility to use space resources will be instrumental for the next steps of humankind in outer space, especially for the use of water *in situ* on the Moon, which will facilitate living conditions for future human settlements, and which can be transformed into rocket fuel for deep space travel.

Another new activity that can provide great opportunities if adequately regulated is commercial human spaceflight. The realisation of several 'firsts' has been one of the highlights of 2021, with various projects finally seeing the light of day.[37] This activity is discussed in *chapters IX and X*.

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34 The USA was first in 2015 with Title IV of the 2015 *US Commercial Space Launch Competitiveness Act* (CSLCA), USC 51303. Luxembourg followed in 2017 with the *Law of 20 July 2017 on the Exploration and Use of Space Resources*, the UAE in 2019 with *Federal Law No. (12) of 2019 on the Regulation of the Space Sector*, and Japan in 2021 with the *Act on Promotion of Business Activities Related to the Exploration and Development of Space Resources* (Act No. 83 of 2021).

35 Cf. art. II and art. I of the Outer Space Treaty, respectively.

36 See *Working Group on Legal Aspects of Space Resource Activities*, https://www.unoosa.org/oosa/en/ourwork/copuos/lsc/space-resources/index.html (accessed in August 2022).

37 See a collection of news items in 'Commercial Spaceflight', *Wired*, https://www.wired.com/tag/commercial-spaceflight/ (accessed in August 2022).

More private citizens will be going to space on suborbital as well as orbital missions and this raises legal questions that should ideally already have been answered. The legal status of private astronauts as opposed to professional ones employed by space agencies must be clarified, as well as the role and legal status of spaceflight operators, who currently have no standing in State-oriented international space law.[38] Analogies can be made with civil aviation, where the status of passengers and operators has been regulated extensively at international, regional and national level. The democratisation of access to space is important, and the technological breakthroughs that are being made will eventually lead to the next step in transporting crew and passengers from point A to point B on Earth via outer space. Therefore, the legal implications of suborbital flights must be clarified, and a suitable regulatory regime adopted, ideally at the global level.

2.3 The Legal Framework for Space Activities: The Netherlands

Previous sub-questions have given an indication of the fact that the role of the national legislator is becoming more relevant in the field of space activities. Where in the past these activities were mainly carried out by States, private entities are taking a more active role and, according to article VI of the Outer Space Treaty, 'national' activities fall under the international responsibility of the 'appropriate' State, which must authorise and supervise those activities. The easiest way to implement that obligation is to set up a licensing regime under national law. According to the national database maintained by the UN Office for Outer Space Affairs (UNOOSA), at the time of writing around forty States have enacted national legislation governing space activities.[39] In some cases a comprehensive legal framework was introduced, while in others a more subject-oriented or partial approach was taken, addressing for instance only space object registration or data protection requirements, but not providing for an overall regulatory scheme for national space activities.

The Netherlands is used as a case study in *chapters XI-XIII*. The *Wet Ruimtevaartactiviteiten* (Space Activities Act) entered into force in 2008 and is implemented by *Agentschap Telecom* (Radiocommunications Agency) of

38 About astronauts, see art. V of the Outer Space Treaty which declares them to be 'envoys of mankind' and accords them assistance in case of accidents, distress or emergency landings. See also the Rescue and Return Agreement. These instruments do not distinguish between professional and private astronauts. The role of spaceflight operators will be subject to State responsibility, as per art. VI of the Outer Space Treaty. Likewise, operator liability does not exist in space law; instead, States are held liable for damage caused by objects launched into outer space, as per art. VII of the Outer Space Treaty and the Liability Convention.

39 See *National Space Law*, UNOOSA, https://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/index.html (accessed in August 2022)

the Ministry of Economic Affairs and Climate Policy.[40] Five licenses have been issued to a variety of actors, and the continued suitability of the legal framework is monitored regularly. By way of example, in 2015 an Administrative Decree was adopted to expand the scope of the Act to unguided satellites which were not covered under the rather restrictive definition of 'space activities' requiring a license.[41] Likewise, a survey on the robustness of the regulatory framework in light of new activities and new legal developments at international level, such as the adoption of the COPUOS Long-Term Sustainability Guidelines in 2019, took place in 2021-2022. These are useful examples of how treaty obligations are transposed into a national legal framework and must be constantly monitored and updated if needed.

3 Methodology and Structure

In this section, the methodology followed in this research is explained, and the structure of the chapters is described.

3.1 Methodology

The methodology used for the papers contained in this study is based on classical legal research. It consists of a normative analysis of the UN legal framework for space activities, composed of treaties, sets of principles contained in resolutions of the UN General Assembly and guidelines adopted by COPUOS, set within the broader context of public international law of which space law is a *lex specialis*. Where appropriate, comparative analysis is applied, looking at for instance the law of the sea, maritime law, air law, EU law and national space legislation. For instance, the law of the sea is relevant in the interpretation of the principle of Common Heritage of Mankind (CHM) when analysing the legality of space resource activities. Maritime law and air transport law are considered in the context of the creation of an STM regime, while air law more generally is also addressed in connection with suborbital flights. EU air transport law is analysed in the context of suborbital flights. EU law is also addressed with regard to STM, as the EU has expressed its intention to take regulatory steps in 2022,

40 *Ibid.*, under 'Netherlands'. The official Dutch text of the *Wet Ruimtevaartactiviteiten* is available at https://wetten.overheid.nl/BWBR0021418/2021-07-01 (accessed in August 2022).

41 Cf. sec. 1 of the Act, which requires a license for 'the launch, the flight operation or the guidance of space objects in outer space'. Unguided satellites launched from abroad by Dutch space companies did not fall under either category and were thus left unlicensed. This was not a desirable result, especially when small unguided satellite activities started to expand considerably. The UN space treaties do not distinguish between guided or unguided space objects. They do impose State responsibility for 'activities in outer space', which should be understood as to include unguided satellites.

in line with its space competence under the Lisbon Treaty.[42] National law is examined for instance in cases where States felt the need to provide clarity at national level in the absence of clarity under international law, such as in the case of space resource utilisation.

The method of interpretation of the UN space treaties follows the rules contained in the Vienna Convention on the Law of Treaties (VCLT),[43] which are recognised as customary international law. Its article 31 provides that a treaty must 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, while article 32 allows the consideration of 'supplementary means of interpretation' if the method prescribed in article 31 does not provide sufficient clarity. In this study, treaty interpretation is conducted through a literal and teleological approach to establish the intention of the drafters at the time of the treaty's conclusion, though generally it adopts a holistic approach and uses the ordinary meaning of the terms of the treaty as the starting point for interpretation, while also taking into account the place of a text within the treaty as well as other relevant sources.

Unfortunately, interpretation of the treaties by international courts and tribunals is not available, as there have been no cases before such courts or tribunals. This may be because no catastrophic events involving major losses to life or property have occurred, as well as because, at least for damage caused in outer space, the required proof of fault will be problematic since no standard of fault has been defined. This might change in the future as and when the potential for conflict and catastrophic damage grows because outer space is increasingly contested and congested.

Besides the legally binding UN space treaties, other elements of the international legal framework agreed within COPUOS have also been analysed. These elements of soft law, i.e., non-legally binding instruments, adopted by consensus and often transposed into the national legal order, have played a significant role in the field of space activities since the 1980's, when agreement on new legally binding instruments no longer seemed possible.[44] Relevant soft law instruments address the mitigation of space debris and the long-term sustainability of space activities, and it is expected that a similar format will prevail for future agreements on other topics. Even though formally not legally binding, the adoption of these soft law instruments by consensus and subsequent state practice and *opinio iuris* may play a role in confirming their subsequent status as customary international law.

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42 Treaty on the Functioning of the European Union, Consolidated version (OJ C 326, 26.10.2012, pp. 47–390).

43 Vienna Convention on the Law of Treaties (adopted 23 May 1969, entered into force 27 Jan. 1980), 1155 UNTS 331. On the sources of international law and on hard law versus soft law, see also the writings by Schrijver, Roberts & Sivakumaran, and Boyle, as cited in n.13-15 (*supra)*.

44 Id.

Moreover, their transposition into national law means that at national level, these instruments become binding on the major players in today's field, private entities.

National space law is a relevant additional primary source of analysis in this study, because of the ongoing trend of privatisation and commercialisation of space activities. National law is of relevance in the analysis of legal issues arising from space resource activities and private human spaceflight, which are areas of space activity where States felt the need to regulate domestically in the absence of international law, or because of the lack of clarity it provides. National space law is relevant more generally in the context of authorisation and supervision of space activities by a growing number of private actors such as the launch of constellations of thousands of satellites that must be authorised, supervised and registered. National law is also expected to play a role in the implementation of the COPUOS long-term sustainability guidelines and future soft law instruments in the field of STM and the utilisation of space resources that may be adopted in international fora such as COPUOS.

Besides primary sources, the research also uses secondary sources such as legal academic scholarship, complemented with news articles and websites.

Finally, this research is informed by the vast experience the author has gained over the years, for instance in consultancy work for governments, international organisations and private entities. These experiences converge in the viewpoints and proposals made in this study and form an important part of its methodology.

3.2 Structure

The main body of this study is divided into thirteen chapters, preceded by this Introduction (*chapter I*).

Chapter II introduces Part A and provides a setting of the scene by explaining the background and history of space law-making, with a focus on the Outer Space Treaty. It recounts the negotiating history of that treaty and the four subsequent ones, explaining their main principles. The chapter also gives an outlook on the future of space law-making, which may evolve in the form of soft law rather than legally binding treaties.

Chapter III addresses a specific current challenge to space activities, viz., space debris. It analyses what the UN space treaties prescribe, before moving to a discussion of relevant soft law instruments, such as the COPUOS debris mitigation guidelines and the difficult process towards the adoption of the COPUOS long-term sustainability guidelines. The next step, the removal of inactive objects from space, also referred to as active debris removal, is also briefly touched upon.

Chapter IV contains a transcript in the form of a blogpost of the annual Meijers Lecture this author was honoured to give at Leiden Law School in 2021. The chosen theme that year was sustainability and hence the lecture

focused on sustainability in space. It sketches the landscape of space activities, which puts the continued benefit of space exploration for current and future generations to the test. Several initiatives are highlighted, including activities of the International Institute of Air and Space Law of Leiden Law School, where the author started her academic career in 1985.

Chapter V shifts the focus to future challenges and provides insight in the topic of STM. It draws comparisons with the law of the sea and air law which can serve, to a certain extent, as a model for the development of an STM regime for outer space activities, and highlights how and why several principles contained in the space treaties are relevant in this context. The chapter also describes the developments in COPUOS where STM was adopted as formal agenda item, as well as several non-governmental initiatives which indicate that private actors themselves are well aware of the need to act in establishing 'rules of the road' for space activities.

Chapter VI zooms in on the potential conflict between different legitimate uses of outer space, one commercial and the other scientific, and how such a conflict can be solved. More specifically, it explains the disturbance caused by the large satellite constellation being built by SpaceX, named Starlink, to astronomical observations, which suffer from the reflection of sunlight by the satellites. The chapter indicates which principles of the space treaties could be relevant for addressing this problem, reviews possible technical solutions proposed by the industry in their discussions with the astronomical community and explains why the initial legal arguments brought forward by this community were not successful. It then makes several suggestions for action at national and international level that could be helpful, including interventions under relevant agenda items in COPUOS by permanent observers such as the International Astronomical Union.

Chapter VII introduces Part B, addressing future opportunities that will require adequate regulation, and focuses on the use of lunar resources as a first example. It provides an extensive analysis of hard and soft law relevant for this topical subject and gives an overview of the national laws that were adopted by a number of States in the absence of legal certainty provided by the space treaties, starting with the USA in 2015. The chapter then moves to developments in COPUOS, describing the early years of contentious discussions since 2016 and the gradual trend towards acceptance of the legality of space resource activities, accompanied by continuing difficulties in reaching agreement on a way forward. The chapter also examines concurrent developments such as the adoption of NASA's Artemis Accords in 2020 and several non-governmental initiatives, including the work of the Hague International Space Resources Working Group, which adopted twenty Building Blocks for the development of an international framework on space resource activities in 2019. As in the previous chapter, here too the importance of continued debate in COPUOS is underlined, even if progress will be slow.

Chapter VIII continues the discussion of this fascinating subject in French, the 'home-language' of the author due to her international family-setting, and one of the official languages of the UN. It contains similar analysis, focusing mostly on the Outer Space Treaty and the Moon Agreement, and presents updates about the process in COPUOS towards the adoption of an agreement to establish a space resource working group. The importance of satisfying the interests of pioneering investors and technology developers while safeguarding the need for equitable sharing of benefits is highlighted.

Chapter IX introduces the topic of human spaceflight and gives an overview of orbital and suborbital human spaceflight. For the former, it focuses on the International Space Station (ISS), a unique international cooperative project among fifteen States, framed by an innovative multi-layered legal framework, which could serve as a model for future cooperative settlements in space or on celestial bodies.[45] Suborbital flights are more complex in terms of legal qualification, as these flights take place at the border between air and space, without there being a formal legal boundary between the two. The USA enacted national legislation to regulate this activity, just as it did in the field of space resource activities. At the international level, the consequences of applying either air or space law are summarised, and the actions of, and interactions among the International Civil Aviation Organisation (ICAO) and UNOOSA are explained. The chapter concludes that a decision on applicable law is needed for this industry to emerge and deliver on the promises of democratic access to space and opening the perspective of fast point-to-point transportation on Earth via outer space.

Chapter X continues the discussion of suborbital flights and zooms in on two specific aspects that require clarification, viz., liability, both second-party or contractual liability and third-party liability, and insurance.[46] The chapter is set against the background of the successful flights of the two major players in this industry in 2021, Virgin Galactic and Blue Origin, which underline the urgency of finding solutions about the applicable law. The chapter focuses on institutional aspects regarding the roles of ICAO, the EU and/or UNOOSA. It then provides extensive analysis of substantive law in the field of liability and insurance and the consequences of applying either air law, including EU air transport law, which are both well developed and benefit from an extensive body of case law, or space law, which lacks several relevant elements in those fields. The chapter recommends that although interim solutions borrowing from both branches of law and

45 In addition to the analysis of the ISS legal framework in ch. IX of this study, see also https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/International_Space_Station/International_Space_Station_legal_framework (accessed in August 2022).

46 Contractual liability can arise when a paying passenger suffers damage during a suborbital flight, whereas third-party liability would govern damage sustained by 'innocent bystanders' who are not party to the contract between the operator and the passenger.

the adoption of national law are acceptable for the short term, in the longer term the development of a *sui generis* regime would be the best solution to provide legal certainty to all stakeholders.

Chapter XI is the first of three chapters addressing the Netherlands, which make up Part C of the study. This chapter gives a detailed perspective on the topic of registration of objects launched into outer space under various UN documents including both hard and soft law, and then focuses on the Netherlands. It describes the legal framework and explains the Dutch interpretation of the concept of the launching State. Under international space law, one of the launching States of a space object must register it in its national registry and with the UN. The chapter explains that the Netherlands does not consider itself as launching State of a space object whose launch from abroad was procured by a Dutch private entity, and hence it will not accept civil liability for damage caused by that object. The Netherlands would prefer in such cases to conclude a bilateral agreement with the other launching State from whose territory the launch took place, to apportion liability, as provided for in Article V of the Liability Convention. The chapter further explains how the scope of the Dutch law was expanded in 2015 to regulate unguided satellite activities, which were hitherto excluded, and hence not licensed.

Chapter XII provides a more detailed explanation of the evolution of the regulation of small satellites in the Netherlands, including market developments in that field. It describes how initially certain *ad hoc* solutions were adopted to address practical issues, and how the 2015 expansion of the scope of the law offered a more robust solution. This means that operators of small satellites require a license and must obtain liability insurance, but the government accepts a lower level of insurance for in-orbit operations in view of the low risk of re-entry, and hence close to zero probability of absolute liability for damage on Earth, and on the condition that launch insurance is included in the launch contract. All in all, this demonstrates a pragmatic approach towards ensuring compliance with treaty obligations while taking into account the needs of stakeholders.

Chapter XIII provides a practical overview of the Dutch legal framework for space activities, geared towards practitioners and focusing on procedures, licensing processes and conditions and requirements, including insurance. It explains the distinctive characteristics of the legal framework and includes a section on current developments and a future outlook.

Lastly, the concluding part of the study offers answers to the research questions and provides a view of the future (*chapter XIV*), followed by an *Annex* with a list of the original sources of the chapters.

A:

The Legal Framework for Space Activities: Current and Future Challenges

II The Peaceful Uses of Outer Space*

Abstract

The creation of space law is rooted in the aftermath of the Cold War. The two world powers of the time – the United States and the USSR – joined forces in the UNCOPUOS (UN Committee on the Peaceful Uses of Outer Space) to introduce law to outer space and ensure that the use and exploration of this domain was conducted for peaceful purposes.

Against this backdrop, the negotiations underlying the drafting of the Magna Carta of outer space – the Outer Space Treaty – demonstrate how these two world powers set aside various political differences to reach a legal compromise for the benefit of the world as a whole. Today, half a century after this milestone, the landscape of the use and exploration of outer space has changed dramatically, particularly in terms of the technology involved. As a result, the question is whether international space law and UNCOPUOS are still able to provide a relevant framework within which the peaceful use and exploration of outer space can progress.

Keywords: space law, outer space, COPUOS, Outer Space Treaty, peaceful purposes

1 Introduction

This chapter addresses the context in which the law of outer space has evolved under the auspices of the United Nations (UN) and indicates how the most fundamental legal instrument relating to outer space – the "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies" – was formulated and adopted. Further, this chapter provides a brief overview of the key aspects of the UN legal regime for space activities and indicates its effectiveness over time. The chapter concludes with an assessment of the robustness of this regime in view of future developments and new activities in the highly dynamic field of space exploration and use. To this end, it will be argued that the drafters of the UN space treaties demonstrated great

* *The Oxford Handbook of United Nations Treaties*, Simon Chesterman, David M. Malone and Santiago Villalpando (eds.), (Oxford University Press, 2019), pp. 181-198, DOI: 10.1093/law/9780190947842.003.0012 (with Roberto Cassar).

wisdom, vision, and craftsmanship when creating this legal regime that has stood the test of time, despite the challenges it has faced and will continue to face as the privatization and commercialization of space activity increase and necessitate a further evolution of its constituent rules.

The law of outer space primarily lays down what is, and what is not permitted when using and exploring outer space. Space law is composed of hard law and soft law; it includes instruments containing legally binding obligations (i.e., "hard" law),[1] as well as non-legally-binding instruments used to express preferences, rather than obligations, that States should act or refrain from acting in a specific manner (i.e., "soft" law).[2] The present chapter mainly focuses on the evolution of the former, as it is comprised of treaties, whereas the evolution of the latter shall only be mentioned in passing.

Before analysing the *evolution* of hard space law, the *genesis* of space law, set amidst the Cold War and the creation of the UN, will be contextualized. Accordingly, the analysis begins in September 1945.

2 The Geopolitical Context of the Genesis of Space Law

At the end of World War II, a vacuum of power engulfed Europe and separated the two great powers of the time: the United States of America and the Union of Soviet Socialist Republics (USSR).

As history goes on to prove, it was impossible for these two powers to fill this vacuum without bruising each other's interests.[3] Conceivably the most fundamental disagreement between the United States and the USSR was whether capitalism or socialism was the best socioeconomic system to attain modernity.[4] So strong was this ideological conflict that it not only percolated through the global political arena,[5] but morphed over time into a military one as both powers began to acquire and expand stockpiles of nuclear weapons capable of destroying humanity as a whole.[6] Although the international landscape was thus dominated by an intensely bipolar structure of world power that in its own right yielded a form of stability and predictability, this came at the enormous price of a risk of nuclear war.[7]

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1 Kenneth W Abbott and Duncan Snidal, "Hard and Soft Law in International Governance" (2000) 54 Intl Org 421.

2 Alan Boyle and Christine Chinkin, *The Making of International Law* (OUP 2007) 212; Joseph Gold, *Interpretation: The IMF and International Law* (Kluwer 1996) 301.

3 John Lewis Gaddis, *We Now Know: Rethinking Cold War History* (Clarendon 1997) 11.

4 Naoko Shibusawa, "Ideology, Culture, and the Cold War" in Richard H Immerman and Petra Goedde (eds), *The Oxford Handbook of the Cold War* (OUP 2013) 32, 41.

5 Allen Lynch, *The Soviet Study of International Relations* (CUP 1987) 95.

6 Akira Iriye, "Historicizing the Cold War" in Immerman and Goedde (n 4) 15, 21.

7 Douglas A Ross, "Multilateralizing the Nuclear Disarmament Process: Next Steps after the START Agreement" in Edward McWhinney, Douglas Ross, Grigory Tunkin, and Vladlen Vereshchetin (eds), *From Coexistence to Cooperation: International Law and Organization in the Post-Cold War Era* (Martinus Nijhoff 1991) 62.

This risk reached even more distressing heights some 10 years into the Cold War, specifically on October 4, 1957, for on that day, by successfully launching the first artificial satellite "Sputnik I" into outer space, the USSR demonstrated that it possessed the ability to launch intercontinental ballistic missiles and deliver nuclear warheads to anywhere on earth.[8] In doing so, the USSR brought about a paradigm shift in the invulnerability of the United States. While throughout most of its history the latter had not needed to worry much about the security of its land owing to its geographical separation by the oceans from direct threats,[9] this illusion of its territorial inaccessibility was abruptly dispelled with the launch of *"Sputnik I"*.[10]

Reverting at this juncture to the wake of World War II, we can shift our focus from the unfolding of the Cold War to the synchronous establishment of a new legal world order in lieu of the failed League of Nations.[11] This new organization, eventually named the "United Nations was to symbolize the birth of a new world wherein peace would be effectively safeguarded.[12] The purpose of the UN, therefore, was none other than world peace.[13]

From the above account it follows quite unsurprisingly that, less than six weeks after the launch of "Sputnik I" and its exacerbation of the spectre of nuclear war, the UN General Assembly emphasised the urgency of decreasing the danger of war,[14] and took the stance that outer space should be used *exclusively* for peaceful purposes.[15] This, eventually, not only led to the regulation of an entirely new domain – outer space – whose characteristics and possibilities were hardly known at the time, but it also made the law of outer space quite unlike that of any other area ever regulated under UN auspices, signalling the creation of a new branch of public international law.

Months later, during the first quarter of 1958, the United States and the USSR followed suit: in January, US president Eisenhower suggested in a letter to USSR premier Bulganin that their nations should both agree to use outer space for peaceful purposes only;[16] in March, the USSR submitted a

8 Richard Pipes, *U.S.-Soviet Relations in the Era of Détente* (Westview 1981) 141–42; John Prados, "Cold War Intelligence History" in Immerman & Goedde (n 4) 414, 425.

9 John Lewis Gaddis, *The Cold War: A New History* (Penguin 2005) 15.

10 B Artemov, "O Sovetsko-Amerikanskikh Otnosheniakh" (1958) 11 Mirovaia Ekonomika I Mezhdunarodnye Otnosheniia 15, 22; as cited in William Zimmerman, *Soviet Perspectives on International Relations, 1956–1967* (Princeton University Press 1973) 172.

11 Franz Cede, "Historical Introduction" in Franz Cede and Lilly Sucharipa-Behrmann, *The United Nations: Law and Practice* (Kluwer Law International 2001) 3, 5–6.

12 Evan Luard, *A History of the United Nations: Volume 1: The Years of Western Domi nation, 1945–1955* (Macmillan Press 1982) 17.

13 Hans Kelsen, *The Law of the United Nations: A Critical Analysis of Its Fundamental Problems* (Praeger 1950) 19.

14 UNGA Res 1148 (XII) (14 November 1957), preambular para. 2.

15 *Ibid* para 1(f) (emphasis added).

16 Letter by Dwight D Eisenhower to Nikolai Bulganin (12 January 1958) reprinted in (1958) 38 Department of State Bulletin (USA) 122, 126.

provisional agenda item for consideration by the General Assembly wherein it proposed that outer space should not be used for military purposes.[17]

Although from this rather brief course of events it may be deduced that there was indeed an understanding between the United States and the USSR that some regulation of the use of outer space was required and that such regulation should be dealt with within the newly established UN,[18] this understanding ought to not however eclipse the fact that the two powers disagreed over *how* such regulation was to be achieved. On the one hand, in a draft resolution to the First Committee of the General Assembly,[19] the USSR proposed the establishment of a UN agency for international cooperation in the study of cosmic space.[20] On the other, in a separate draft resolution to the same Committee, the United States and 19 additional States counter-proposed the establishment by the General Assembly of an ad hoc committee on the peaceful uses of outer space.[21]

Pursuant to the counterproposal of the latter, the USSR revised its draft resolution and abandoned the idea of a UN agency,[22] suggesting instead the establishment of a UN committee for cooperation in the study of outer space for peaceful purposes, and a preparatory group thereof consisting of representatives of several States.[23] The United States and its 19 allies,

17 "Union of Soviet Socialist Republics: Request for the Inclusion of an Item in the Provisional Agenda of the Thirteenth Session" (17 March 1958) A/3818; reprinted in GAOR 13th Session Annexes, Agenda Item 60 1.

18 Stephan Hobe, "Historical Background" in Stephan Hobe, Bernhard Schmidt-Tedd & Kai-Uwe Schrogl (eds), *Cologne Commentary on Space Law: Volume 1* (Carl Heymanns Verlag 2009) 4.

19 This draft resolution was submitted to the First Committee since, in September, the UNGA had referred to it a single "Question of Peaceful Use of Outer Space" for consideration and report; Howard J Taubenfeld, "Consideration at the United Nations of the Status of Outer Space" (1959) 53(2) American Journal of International Law (hereafter AJIL) 400.

20 "Union of Soviet Socialist Republics: Draft Resolution" (7 November 1958) A/C.1/L. 219 reprinted in GAOR 13th Session Annexes, Agenda Item 60 4, 4–5. Note that the USSR had already proposed the establishment of such a UN agency in March when it submitted the provisional agenda item for consideration by the UNGA; "Union of Soviet Socialist Republics: Request for the Inclusion of an Item in the Provisional Agenda of the Thirteenth Session" (17 March 1958) A/3818 reprinted in GAOR 13th Session Annexes, Agenda Item 60 1, 3.

21 "Australia, Belgium, Bolivia, Canada, Denmark, France, Guatemala, Ireland, Italy, Japan, Nepal, Netherlands, New Zealand, Sweden, Turkey, Union of South Africa, United Kingdom of Great Britain and Northern Ireland, United States of America, Uruguay and Venezuela: Draft Resolution" (13 November 1958) A/C.1/L.220 reprinted in GAOR 13th Session Annexes, Agenda Item 60 5, 5–6.

22 Philip C Jessup & Howard J Taubenfeld, *Controls for Outer Space and the Antarctic Analogy* (Columbia University Press 1959) 255.

23 The representatives proposed were those of the USSR, the United States, the United Kingdom (UK), France, India, Czechoslovakia, Poland, Romania, the United Arab Republic (UAR), Sweden and Argentina; "Union of Soviet Socialist Republics: Revised Draft Resolution" (18 November 1958) A/C.1/L.219/Rev.1 reprinted in GAOR 13th Session Annexes, Agenda Item 60 5.

all of whom objected to the revised USSR suggestion on the ground that the component States of the proposed preparatory group were either Soviet satellites or unfriendly neutral States,[24] responded by revising their own draft resolution and counter- suggesting that their proposed ad hoc committee consist of a set of different States.[25]

Evidently, a compromise on the composition and permanence of the proposed UN committee was unattainable.[26] Thus, the USSR withdrew its draft resolution, arguing that it had been submitted as a basis for a *unanimous* decision without which it would not be put to a vote.[27] With this withdrawal, the path for the revised resolution of the United States and its allies was cleared, allowing it to be adopted as a whole by 54 votes to 9 with 18 abstentions.[28]

Ultimately and albeit over Soviet bloc dissent,[29] the General Assembly adopted a resolution[30] whereby, in recognizing the common aim that outer space should be used exclusively for peaceful purposes, and in considering that international cooperation in the study and utilization of outer space for peaceful purposes will promote the strengthening of friendly relations among peoples,[31] it established an Ad Hoc Committee on the Peaceful Uses of Outer Space.[32] The Committee on the Peaceful Uses of Outer Space, or COPUOS, was born.

3 The Advent of Space Law

The establishment of COPUOS marks an important milestone in the regulation of the use and exploration of outer space for, by growing over time into *the* forum for international cooperation in the peaceful uses of outer space,[33] this Committee catalysed the advent of space law. With its initial task, this Ad Hoc Committee sought to determine, inter alia, the nature of the legal

24 Jessup and Taubenfeld (n 22) 256.

25 The States suggested were Argentina, Australia, Belgium, Brazil, Canada, Czechoslovakia, France, India, Iran, Italy, Japan, Mexico, Poland, Sweden, the USSR, the UAR, the UK and the United States; A/C.1/L.220/Rev.1, as cited in "Report of the First Committee" (28 November 1958) UN Doc A/4009 reprinted in GAOR 13th Session Annexes, Agenda Item 60 6, 7.

26 Taubenfeld (n 19) 402.

27 "Report of the First Committee" (28 November 1958) A/4009 reprinted in GAOR 13th Session Annexes, Agenda Item 60 6, 8 (emphasis added).

28 *Ibid* 8.

29 Philip C Jessup & Howard J Taubenfeld, "The United Nations Ad Hoc Committee on the Peaceful Uses of Outer Space" (1959) 53(4) AJIL 877.

30 UNGA Res 1348 (XIII) (13 December 1958).

31 *Ibid*, preambular para 1; 8.

32 *Ibid*, para 1.

33 Nandasiri Jasentuliyana, *International Space Law and the United Nations* (Kluwer 1999) 21 (emphasis added).

problems that could arise in the conduct of space activities.[34] When this was completed, in the summer of 1959,[35] COPUOS presented a report[36] to the General Assembly containing a multitude of considerations.

One of these considerations suggested that:

> '[Because] countries throughout the world proceeded on the premise of the permissibility of the launching and flight of space vehicles which were launched, regardless of what territory they passed "over" during the course of their flight through outer space […], there may have been initiated the recognition or establishment of a generally accepted rule to the effect that, in principle, outer space is, on conditions of equality, freely available for exploration and use by *all* in accordance with existing or future international law or agreements.'[37]

Thus, in a legal-first, COPUOS pronounced the unique feature of the "freedom" of outer space[38] – a proposition that went unchallenged by all States.[39] Following its consideration of this report, toward the end of 1959 the General Assembly decided to convert the Committee from ad hoc to permanent.[40] With this now permanent status, COPUOS set out to regulate activities conducted in outer space so as to prevent and avoid the development of haphazard practices dictated by national interests.[41]

COPUOS presented the fruit of its first negotiations to the General Assembly two years later.[42] In its report, COPUOS reiterated and elaborated upon the previous legal consideration of the Ad Hoc Committee that outer space was a res communis.[43] It further formulated two principles of utmost

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34 UNGA Res 1348 (XIII) (n 30) para 1(d).

35 C Wilfred Jenks, *Space Law* (Stevens & Sons 1965) 52–53. This task was completed notwithstanding the refusal of the USSR, Poland, and Czechoslovakia (as well as India and the UAR) to participate; Myres S McDougal, Harold D Lasswell, and Ivan A Vlasic, *Law and Public Order in Space* (Yale University Press 1963) 210. In this regard it is to be stated that India and the UAR presumably kept a distance to avoid involvement in what may have appeared to be a "Cold War" dispute; Jessup and Taubenfeld (n 29) 877.

36 COPUOS "Report of the *Ad Hoc* Committee on the Peaceful Uses of Outer Space" (25 June 1959) A/4141.

37 *Ibid*, 23 para 9 (emphasis added).

38 Walter A McDougall, *The Heavens and the Earth: A Political History of the Space Age* (Basic Books 1985) 192.

39 The "freedom" of outer space also went unchallenged by those States that had re fused to participate since, although they refused to endorse the report of COPUOS, this refusal was directed against the composition of COPUOS rather than the results of its de liberations, meaning in turn that this refusal should not be interpreted as implying rejection of the "freedom" principle; McDougal, Lasswell, and Vlasic (n 35) 211.

40 UNGA Res 1472 A (XIV) (12 December 1959) para 1.

41 "Era infatti urgente evitare lo sviluppo di pratiche dettate esclusivamente da interessi nazionali"; Sergio Marchisio, "Il Diritto delle Attività Spaziali nell'Era della Cooperazione" in Antonello Folco Biagini & Mariano Bizzarri (eds), *Spazio. Scenari di Collaborazione: Note di Diritto Internazionale* (Passigli Editori 2013) 12.

42 See UNGA Res 1721 (XVI) (20 December 1961).

43 *Supra* (n 37). For more on the res communis nature of outer space see Steven Free land and Ram Jakhu, "Article II" in Hobe et al (n 18) 46.

importance, which were sanctioned by the General Assembly in its resolution 1721 (XVI), namely (1) that outer space and celestial bodies, unlike newly discovered continents and seas on earth, are not subject to national appropriation and are free for exploration and use by all States, and (2) that international law, including the Charter of the United Nations, applies to outer space and celestial bodies.[44] These principles are in fact so important that, apart from serving as the foundation upon which contemporary space law is erected,[45] they reverberate in contemporary space law itself.[46]

In the following years, COPUOS continued its institutional consolidation with the establishment of two subsidiary organs in 1962, namely its Legal Subcommittee and its Scientific and Technical Subcommittee.[47] This was followed by an even more remarkable accomplishment when COPUOS submitted, for consideration by the General Assembly, a draft Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Spaces.[48] This declaration (hereinafter the "Declaration of Legal Principles") was adopted by the General Assembly under resolution 1962 (XVIII)[49] and it represents a fundamental step in the codification of space law.[50]

By galvanizing the two principles pronounced in resolution 1721 (XVI) and enshrining a further seven,[51] the Declaration of Legal Principles was the first significant document articulating legal principles on the conduct of activities in outer space.[52] One of the seven additional principles however stands out significantly, especially in terms of the currently increasing privatization and commercialization of space activities. This addition is

44 UNGA Res 1721 A (XVI), para 1.

45 Hobe et al (n 18) 12.

46 Jenks (n 35) 54–55; Katrin Nyman-Metcalf, "Space for the Benefit of Mankind? New Developments and Old Problems" (2009) 34 Annals of Air and Space Law (hereafter AASL) 621, 624.

47 Sergio Marchisio, "The Evolutionary Stages of the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS)" (2005) 31 J Space Law 219, 223.

48 Vladimir Kopal, "United Nations and the Progressive Development of International Space Law" (1996) 7 Finnish Yearbook of International Law 1, 7; Martin Menter, "The Developing Law for Outer Space" (1967) 53 ABA J 703.

49 UNGA Res 1962 (XVIII) (13 December 1963.

50 "Cette Résolution marque une étape fondamentale dans la codification du droit de l'espace"; Armand D Roth, *La Prohibition de l'Appropration et les Régimes d'Accès aux Espaces Extra-Terrestres* (Presses Universitaires de France 1992) 47.

51 UNGA Res 1962 (XVIII). Note that it is paragraphs 2–4 of this resolution that galvanize the two principles proclaimed in resolution 1721 (XVI).

52 Karin Traunmüller, "The 'Declaration of Legal Principles Governing the Activities of States in the Exploration of Outer Space': The Starting Point for the United Nations' Law of Outer Space" in Irmgard Marboe (ed), *Soft Law in Outer Space: The Function of Non- binding Norms in International Space Law* (Böhlau 2012) 145; Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and Other Celestial Bodies: A Proposal for a Legal Regime* (Martinus Nijhoff 2009) 16.

paragraph 6 of the Declaration of Legal Principles, which provides that States shall bear international responsibility for national activities in outer space, including those by nongovernmental entities, and that activities of nongovernmental entities in outer space shall require authorization and continuing supervision by the State concerned.[53]

Resolution 1962 (XVIII), which embodies the cardinal early normative framework for space activities,[54] is thus "the first chapter in the book of space law."[55]

3.1 The Evolution of Hard Space Law

Notwithstanding the swift pace at which COPUOS progressed in its nascent stages, its work appeared to hit a plateau in the three years following the adoption of the Declaration of Legal Principles. As the then-Chairman of the Legal Subcommittee stated during its fifth session toward the end of 1966, "in [those three years] little progress had been made towards ensuring that outer space was used for [the] advancement [of man] and not for his destruction."[56]

Yet, less than half a year later and barely 10 years after the decision was made to regulate this new domain of human endeavour, COPUOS presented to the General Assembly a treaty that the latter unanimously commended,[57] and that eventually became known as the Magna Carta of space law:[58] the "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies" (the "Outer Space Treaty" or OST).[59]

The rationale behind the OST was to crystallize the legal principles set forth in resolution 1962 (XVIII) for, although the latter was adopted unanimously[60] and although States, in principle, were and are to respect

53 UNGA Res 1962 (XVIII) (n 49) para 6.

54 Hobe et al (n 18) 13.

55 Bin Cheng, "United Nations Resolutions on Outer Space: 'Instant' International Customary Law?" (1965) 5 Indian J. Int. Law 23.

56 COPUOS LSC "Summary Record of the Fifty-Seventh Meeting" (20 October 1966) A/AC.105/C.2/SR.57 2–3; Bin Cheng, *Studies in International Space Law* (Clarendon 1999) 216.

57 UNGA Res 2222 (XXI) (19 December 1966).

58 Stephan Hobe, "Outer Space as the Province of Mankind – An Assessment of 40 Years of Development" (2007) 50 Proceedings of the International Institute of Space Law (hereafter PIISL) 442; Francis Lyall and Paul B Larsen, *Space Law: A Treatise* (2nd ed., Routledge 2018) 49.

59 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (adopted 19 December 1966, entered into force 10 October 1967) 610 UNTS 205. As at January 1, 2018, the OST has been ratified by 107 States and signed by another 23 States; COPUOS LSC "Status of International Agreements relating to activities in outer space as at 1 January 2018" (9 April 2018) A/AC.105/C.2/2018/CRP.3 10.

60 James Crawford, *Brownlie's Principles of Public International Law* (OUP 2012) 42, fn 143.

it by virtue of the maxim *venire contra factum proprium non valet*,[61] being a resolution, it could not be deemed legally binding.[62]

The OST rectified this weakness, and with virtually all its provisions, except Article IV, being already agreed upon in the Declaration of Legal Principles,[63] it expanded the latter into a *binding* legal framework for the exploration and use of outer space.[64]

Prior to analysing how the negotiations evolved from that day onward, it is vital to mention that they were successful first and foremost by virtue of the then-Chairman of the LSC of COPUOS: Judge Manfred Lachs. It is beyond any doubt that the United States and the USSR reached a compromise and eventual agreement on the OST thanks to his diplomatic skills and legal brilliance, making him, in his own right, as much a father of this treaty as the States that negotiated it.[65]

3.2 Negotiating the Outer Space Treaty

Set amidst the Cold War, it comes as no surprise that the OST was the product of negotiations between the two major players thereof: the United States and the USSR. These negotiations in fact began on May 11, 1966, nearly three months after the landing of the Soviet "Luna IX" on the moon.[66]

On that day, the United States proposed to the USSR an outline of 12 points, which, the former opined, were to be included in a treaty governing

61 "'To come against one's own fact (is not allowed).' A maxim of customary international law meaning that one may not set one's self in contradiction to one's own previous conduct", Aaron X Fellmeth and Maurice Horwitz, *Guide to Latin in International Law* (OUP 2009) 290.

62 Alex Meyer, "Der Weltraumvertrag" (1967) 16 Zeitschrift für Luft- und Weltraumrecht (hereafter ZLW) 65, 69; UN Office of Legal Affairs "Use of the Terms 'Declaration' and 'Recommendation'" (2 April 1962) E/CN.4/L.610 1–2; Cheng (n 56) 133.

63 Bin Cheng, "The 1967 Outer Space Treaty: Thirtieth Anniversary" (1998) 23 Air and Space Law 156.

64 *Ibid*; Bin Cheng, "Outer Void Space: The Reason for this Neologism in Space Law" (1999) Australian Intl Law J 1, 4.

65 See the chapter about Manfred Lachs' contributions to the field of space law by Francis Lyall in Stephan Hobe (ed), *Pioneers of Space Law* (Nijhoff 2013), 193–209. Among Manfred Lachs' many writings in the field, special mention should be made of his excellent book *The Law of Outer Space, an Experience in Contemporary Law-Making* (Sijthoff 1973, republished by the IISL, Nijhoff 2010) and his course *The International Law of Outer Space* at The Hague Academy of International Law, Recueil des Cours (1964-III) 1–114.

66 Cheng, (n 56) 220. Note that negotiations between the United States and the USSR had already been undertaken with regard to the Declaration of Legal Principles. For in stance, in negotiating this resolution, the United States and USSR reached a compromise on whether private activities in outer space could be allowed, with the former being in favour and the latter against. For more on the matter see Jenks (n 35) 210–12.

the exploration of the moon and other celestial bodies.[67] Swift in its reply, on May 30, the USSR requested the inclusion of the item "Conclusion of an international agreement on legal principles governing the activities of States in the exploration and conquest of the Moon and other celestial bodies" in the agenda of the 21st session of the General Assembly.[68]

Accordingly, the USSR submitted the text of a draft treaty on June 16, 1966,[69] in light of which the United States submitted the text of its own draft treaty that same day.[70] Juxtaposing the draft of the USSR with that of the United States, a clear difference between the two emanates. The Soviet draft was intended as a general treaty on principles governing the activities of States in the exploration and use of outer space, including the moon and other celestial bodies,[71] and thus may be regarded as a direct implementation of the Declaration of Legal Principles.[72] The US draft had its scope limited to the moon and other celestial bodies,[73] and rather than attempting to convert resolution 1721 (XVI) and the Declaration of Legal Principles into hard law, it represented more of an adaptation of these resolutions to the special circumstances of the moon and other celestial bodies.[74]

Thus, at the opening of the fifth session of the Legal Subcommittee, on July 12, 1966, the debate revolved around two drafts of a rather different nature, and although it soon became clear that most States were in favour of the USSR draft, substantial support was also found for many of the novel features included in the US draft.[75]

The general debate ended in a spirit of cooperation between the United States and the USSR, with each declaring its readiness to consider the possibility of incorporating in its draft those features that appeared

67 "Letter dated 16 June 1966 from the Permanent Representative of the United States of America addressed to the Chairman of the Committee on the Peaceful Uses of Outer Space" (17 June 1966) A/Ac.105/32. The 12 points were namely: freedom of exploration, non-appropriation, freedom of and cooperation in scientific investigations, reporting of findings, open access to all areas, non-militarization, jurisdiction of the launching State, ownership of objects launched into space, mutual assistance among astronauts, avoidance of harmful contamination, settlement of disputes, and final clauses; *ibid.* 1-2.

68 "Union of Soviet Socialist Republics: request for the inclusion of an item in the provisional agenda item of the twenty-first century" (31 May 1966) A/6341.

69 "Letter dated 16 June 1966 from the Permanent Representative of the Union of Soviet Socialist Republics to the United Nations Addressed to the Secretary-General" (16 June 1966) A/6352.

70 "Draft Treaty Governing the Exploration of the Moon and Other Celestial Bodies: Letter dated 16 June 1966 from the Permanent Representative of the United States of Ameri ca addressed to the Chairman of the Committee on the Peaceful Uses of Outer Space" (17 June 1966) A/AC.105/32.

71 Paul G Dembling and Daniel M Arons, "The Evolution of the Outer Space Treaty" (1967) 33 J Air Law and Commerce 419, 428.

72 Cheng (n 56) 221.

73 Dembling and Arons (n 71) 428.

74 Cheng (n 56) 221.

75 *Ibid*.

in the proposal of the other.[76] By way of example, the United States not only agreed to enlarge the scope of the treaty to apply to celestial bodies *and* outer space,[77] but also indicated its general preparedness to accept all proposals in the draft of the USSR that incorporated the terms of previous General Assembly resolutions on outer space.[78] Likewise, the USSR not only accepted the principles of freedom of, and international cooperation in scientific investigations contained in the draft of the United States,[79] but also demonstrated readiness to accept the proposal of the United States of free access to all installations on celestial bodies.[80]

As a result, agreement was reached quite smoothly on what consequently became the first nine articles of the treaty, even though insofar as the substantive articles of the treaty were concerned, agreement had yet to be reached on several facets.[81] One of these facets that proved to be a major stumbling block for the treaty as a whole was the Soviet proposal that each contracting State must grant equal rights, subsequently limited to equal facilities for tracking space objects, to all other contracting States engaged in the exploration of outer space.[82] When the Legal Subcommittee resumed its fifth session on September 12, 1966, it became clear that its members, bar those in the Soviet bloc, were generally unwilling to agree to the equivalent of an unconditional "most-favoured nation clause" on tracking facilities.[83] This seemed problematic since the USSR made it clear that it regarded this provision *a sine qua non* of the treaty; without an agreement on this article, the USSR was not prepared to take the treaty further.[84]

No further progress had been made by the time COPUOS reconvened on September 19, 1966.[85] However, on September 22, the United States informed the USSR that, if the latter truly desired to provide for tracking coverage from US territory, it was prepared to discuss with Soviet representatives the technical and other requirements involved with a view to reaching some mutually beneficial agreement.[86] Consequently, on October 4, the USSR submitted a revised draft of its treaty, the terms of which show that it had reached a compromise with the United States on

76 COPUOS LSC "Summary Record of the Sixty-Second Meeting" (24 October 1966) A/AC.105/C.2/SR.62 10–12.
77 COPUOS LSC "Summary Record of the Sixty-Third Meeting" (20 October 1966) A/AC.105/C.2/SR.63 2–3 (emphasis added).
78 Cheng (n 56) 222.
79 COPUOS LSC "Summary Record of the Sixty-Third Meeting" (n 77) 4–5.
80 *Ibid*.
81 Cheng (n 56) 222.
82 *Ibid* 222–23; Dembling and Arons (n 71) 442.
83 Cheng (n 56) 223.
84 *Ibid*.
85 Dembling and Arons (n 71) 444.
86 UN, First Committee of the General Assembly "Twenty-First Session" (22 September 1966) A/PV.1412 41.

tracking facilities,[87] along with agreement on several other facets such as the preamble, the use of military equipment, and the conditions governing visits to installations on celestial bodies.[88]

With this progress, minor formalistic issues were creased out and, on December 8, complete agreement was achieved.[89] The agreed text was submitted to the First Committee of the General Assembly on December 15,[90] which adopted it without objection on December 17.[91] Ultimately, the treaty was opened for signature on January 27, 1967, and came into force on October 10, 1967.

3.3 Beyond the Outer Space Treaty

Now that we have seen how the OST was brought to life, it is possible to provide some insight on its substance. Insight can be also provided on the substance of the four other treaties that followed the Magna Carta of space law, which, along with their predecessor, form the hard law regime of outer space.

Composed of 13 substantive articles,[92] the OST lays down *the* fundamental legal rules on the use and exploration of outer space. While Articles I, II, and III of the OST expand upon what by then had become rather clear principles of space law-that is, the principles that the use and exploration of outer space shall be the province of all mankind, that any sovereign or territorial claims in outer space are prohibited, and that space activities shall not violate international law, including the UN Charter-its subsequent provisions articulate an array of diverse and often innovative principles.

Key among these other articles is Article IV, which, although far less celebrated than the previous three, provides the principle that the moon and other celestial bodies are to be used exclusively for peaceful purposes.[93]

87 Cheng (n 56) 224.

88 *Ibid.*

89 *Ibid.*

90 "International Co-operation in the Peaceful Uses of Outer Space: Report of the Committee on the Peaceful Uses of Outer Space" (15 December 1966) A/AC.1/L.396; "International Co-operation in the Peaceful Uses of Outer Space: Report of the Committee on the Peaceful Uses of Outer Space" (15 December 1966) A/AC.1/L.396/Add.1; "International Co-operation in the Peaceful Uses of Outer Space: Report of the Committee on the Peaceful Uses of Outer Space" (15 December 1966) A/AC.1/L.396/Add.2.

91 UN, First Committee of the General Assembly "Twenty-First Session" (17 December 1966) A/AC.1/SR.1493 445, para 86.

92 Articles XIV to XVI of the OST only deal with certain non-substantive formalities; Carl Q Christol, *Modern International Law of Outer Space* (Pergamon Press 1982) 49.

93 Note that the term "peaceful purposes" poses some difficulty as to its true meaning; Julia Neumann, "An Interpretation of the Outer Space Treaty after 40 Years" (2007) 50 PIISL 431, 437. This notwithstanding, State practice over the years has generally support ed the view that "peaceful purposes" means "non-aggressive purposes"; therefore, al though space objects have been used extensively to support military operations here on earth, weapons per se have never actually been deployed in outer space; Space Security Index 2004, "Chapter 2: Space Security Laws, Policies, and Doctrines" (2005) 30(2) AASL 343, 346.

The importance of this principle cannot be stressed enough: were it not for this principle, it is plausible that, by now, weapons would have been warehoused in outer space, with earth being their primary target. It is therefore by virtue of Article IV that life on earth has been able to flow on in relative peace.

Over and above Articles I, II, III, and IV, the other articles of the OST *inter alia* provide that States are internationally responsible for governmental and private activities in outer space,[94] that States are liable for damages caused by space objects they launch,[95] and that States retain jurisdiction and control over the space objects they register.[96]

Although the OST was a momentous leap in the evolution of space law, in view of the broadness of its legal rules it soon came to be seen as requiring further elaboration,[97] and to this end four more treaties were negotiated under the auspices of the UN. These four subsequent treaties did not deviate from the OST; mostly, they served to elaborate on the basic principles enshrined within it so much so that they could be considered as a *lex specialis* thereof. However, a unique and new feature that was introduced in these four treaties is the possibility for intergovernmental organizations to declare their acceptance of the rights and obligations under them, and indeed, several of such organizations[98] have done so for the first three treaties addressed in this section.

The first of these additional treaties was the Agreement on the Rescue of Astronauts, the

Return of Astronauts and the Return of Objects Launched into Outer Space (the "Rescue Agreement"), adopted on December 19, 1967.[99] This treaty is an earth-oriented instrument as it provides that a State that learns that either an astronaut, or a space object, has landed anywhere on earth other than in the territory of another State, shall notify the launching authority and the Secretary-General of the UN of that landing,[100] and shall help return the astronaut or space object safely to the launching authority.[101]

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94 OST (n 59) art VI.

95 *Ibid* art VII.

96 *Ibid* art VIII.

97 Frans von der Dunk, "International Space Law" in Frans von der Dunk and Fabio Tronchetti (eds), *Handbook of Space Law* (Edward Elgar 2015) 39.

98 These IGOs are the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) and the European Space Agency (ESA) for the first three treaties hereunder addressed, the European Telecommunications Satellite Organization (EU TELSAT) for the second and the third, and the Intersputnik International Organization of Space Communications for the third treaty only.

99 Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (adopted 19 December 1967, entered into force 3 December 1968) 672 UNTS 119. As at January 1, 2018, the Rescue Agreement has been ratified by 96 States, signed by 23 States, and 2 international organizations have deposited a declaration of acceptance of its rights and obligations; COPUOS LSC (n 59).

100 Rescue Agreement arts 1 and 5.

101 *Ibid* arts 2 to 5.

Following this treaty came the Convention on International Liability for Damage Caused by Space Objects (the "Liability Convention") of November 29, 1971,[102] which was craft ed so as to build upon the principle of liability held within Article VII of the OST.[103] In achieving this, the Liability Convention provides that a "launching State"[104] is absolutely liable to pay compensation for damages caused by its "space object"[105] on the surface of earth or to aircraft in flight.[106] Furthermore, a State is liable to pay compensation if its space object causes "damage"[107] elsewhere than on the surface of the earth to a space object, or persons or property on-board it, due to the fault of persons for whom it, as a State, is responsible.[108]

The third treaty following the OST was the Convention on Registration of Objects Launched into Outer Space (the "Registration Convention"), adopted on November 12, 1974.[109] This treaty refined the registration principle contained in Article VIII of the OST by establishing, at its core, a dual system of registration of objects launched into outer space.[110] Thus, the Registration Convention first provides that a "launching State"[111] is to maintain a registry of space objects and enter on it a space object that it has

102 Convention on International Liability for Damage Caused by Space Objects (adopted 29 November 1971, entered into force 1 September 1972) 961 UNTS 187. As at January 1, 2018, the Liability Convention has been ratified by 95 States, while 19 States have signed it and 3 international organizations have deposited a declaration of acceptance of its rights and obligations; COPUOS LSC (n 59).

103 von der Dunk and Tronchetti (n 97) 82.

104 A "launching State" is defined as "a State that launches or procures the launch of a space object; a State from whose territory or facility a space object is launched"; Liability Convention (n 102) art I(c).

105 A "space object" is defined as "[including] component parts of a space object as well as its launch vehicle and parts thereof"; *ibid*. art I(d). In this regard, it is acknowledged that this description is effectively a non-definition since it is (clearly) circular and difficult to interpret; Stephan Hobe, "International Space Law in Its First Half Century" (2006) 49 PIISL 373, 375; Henry R Hertzfeld, "A Roadmap for a Sustainable Space Law Regime" (2012) 55 PIISL 299, 303.

106 Liability Convention (n 102) art II.

107 "Damage" is defined as "loss of life, personal injury, or other impairment of health, or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organisations"; *ibid*. art I(a).

108 *Ibid* art III.

109 Convention on Registration of Objects Launched into Outer Space (adopted 12 November 1974, entered into force 15 September 1976) 1023 UNTS 15. As at January 1, 2018, the Registration Convention has been ratified by 67 States, signed by 3 States, and 4 international organizations have deposited a declaration of acceptance of its rights and obligations; COPUOS LSC (n 59).

110 Fabio Tronchetti, *Fundamentals of Space Law and Policy* (Springer 2013) 12; Hobe (n 105) 375.

111 A "launching State" is defined as "a State that launches or procures the launch of a space object; a State from whose territory or facility a space object is launched"; Registration Convention (n 109) art I(a).

launched into earth orbit or beyond,[112] then it further creates a UN Registry that fundamentally serves the same purpose.[113]

Last, the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the "Moon Agreement") was adopted on December 5, 1979.[114] The majority of this treaty, like the three previous ones, reiterates certain well-established principles such as that the moon shall be used exclusively for peaceful purposes,[115] and that the exploration of the moon shall be the province of all mankind.[116] Nevertheless, this treaty goes beyond the Magna Carta of space law by addressing not only the "use" and "exploration" of the moon, but also the "exploitation" of its natural resources. It is impossible to over look the fact that, in doing so, the Moon Agreement is much less successful than its predecessors.[117] This stems from its classification of the moon and the natural resources thereof as "the common heritage of mankind,"[118] a concept derived from the law of the sea, even though the Moon Agreement specifies that this term should "find its ex pression in [its] provisions."[119] Suffice it to say that the concept of common heritage of mankind in the Moon Agreement has led to much debate and disagreement, especially in recent years with the prospect of commercially harvesting space resources having become more realistic.[120] Consequently, the limited role that the Moon Agreement has played thus far is not likely to change, despite its unanimous adoption by the General Assembly.

112 Registration Convention art II.

113 *Ibid* art III; Cheng, (n 56) 159.

114 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (adopted 5 December 1979, entered into force 11 July 1984) 1363 UNTS 3. As at January 1, 2018, the Moon Agreement has been ratified by 17 States and signed by 4 States; COPUOS LSC "Status of International Agreements relating to activities in outer space as at 1 January 2017" (n 59).

115 Moon Agreement art 3(1).

116 *Ibid*. art 4(1).

117 Stephan Hobe, "The Moon Agreement - Let's Use the Chance!" (2010) 59 ZLW 372.

118 Moon Agreement (n 114) art 11(1).

119 *Ibid*.

120 Stephan Hobe, Peter Stubbe, and Fabio Tronchetti, "Historical Background and Context" in Stephan Hobe, Bernhard Schmidt-Tedd, and Kai-Uwe Schrogl (eds), *Cologne Commentary on Space Law: Volume 2* (Carl Heymanns Verlag 2013) 336. Note that art 11(7)(d) of the Moon Agreement requires an "equitable sharing" by all States parties in the benefits derived from the exploited natural resources of the moon. This constitutes the most controversial idea, if not also the greatest deterrent, of the said treaty; Ram Jakhu, Steven Freeland, Stephan Hobe and Fabio Tronchetti, "Article 11 (Common Heritage of Mankind/International Regime)" in Hobe et al., *supra*, at 398.

4 The Future of Hard Space Law

After the Moon Agreement of 1979, no new space treaties were adopted under the auspices of the UN, and thus the dynamic phase of treaty-making came to an end. The lack of new treaties could be attributed to a lack of political will among States, sometimes referred to as "treaty fatigue/congestion" also seen in other areas of international law.[121]

Instead, there was a return to declaring legal principles in the form of UN General Assembly resolutions, leading to several new "soft law" instruments. However, as one of the early Chairs of COPUOS recently put it:

> '[…] while the first of these resolutions, in particular resolution 1962 (XVIII) of 13 December 1963, had the objective to launch the process of international cooperation in space and thus create a basis for a space legislation process later, now the establishment of a number of sets of principles by UN General Assembly resolutions had to regulate more special and more technical categories of space activities. In this way the sets of principles elaborated and adopted by the General Assembly included principles governing television broadcasting (1982), remote sensing of the earth from space (1986), the use of nuclear power sources in outer space (1992) and a Declaration on international cooperation for the benefit and in the interest of all States, taking into particular account the needs of developing countries (1996).'[122]

A third wave of General Assembly resolutions adopted in the early part of the twenty-first century have addressed certain concepts contained in the treaties, such as the concept of the launching State,[123] the practice of States in registering space objects,[124] and the adoption of national legislation to implement the obligation to authorize and supervise activities by nongovernmental entities.[125] Interestingly, however, each of these resolutions contains a preambular paragraph stating that nothing in the resolution

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121 Edith Brown Weiss, "International Environmental Law: Contemporary Issues and the Emergence of a New World Order" (1993) 81 Georgetown LJ 675, 697. Note that the essence of treaty congestion lies in the appearance of too much law, too fast; Donald K Anton, "'Treaty Congestion' in Contemporary International Environmental Law" in Shawkat Alam, Jahid Hossain Bhuiyan, Tareq MR Chowdhury, and Erika J Techera (eds), *Routledge Handbook of International Environmental Law* (3rd ed., Routledge 2015) 652. Note further that, although EB Weiss originally coined the concept of "treaty congestion" in terms of international environmental law, this concept can be equally applied to public international law in general; Joost Pauwelyn, Ramses A Wessel, and Jan Wouters, "When Structures Become Shackles: Stagnation and Dynamics in International Lawmaking" (2014) 25 Eur. J Intl Law 733,739.

122 Peter Jankowitsch, "The Outer Space Treaty: Its First Fifty Years" (2017) 60 PIISL 3, 7–8. The four resolutions mentioned by Jankowitsch respectively are: UNGA Res 37/92 (10 December 1982); UNGA Res 41/65 (3 December 1986); UNGA Res 47/68 (14 December 1992); UNGA Res 51/122 (13 December 1996).

123 UNGA Res 59/115 (10 December 2004).

124 UNGA Res 62/101 (17 December 2007).

125 UNGA Res 68/74 (11 December 2013).

constitutes an authoritative interpretation of, or proposed amendment to, any of the UN treaties on outer space.

While it makes sense, of course, that a soft-law instrument such as a UN General Assembly resolution cannot be considered as treaty interpretation unless its specific intent and purpose was to serve as such, in the absence of jurisprudence by, for instance, the International Court of Justice, this is also somewhat regrettable. Nonetheless, the resolutions provide useful insight in the *opinio juris* of States, and could, if accompanied by State practice, be seen as evidence of customary law.[126]

The question of how effective and influential the UN treaty regime has been over time is a valid one, as is the question whether that regime can address future challenges and accommodate all legal issues raised by recent developments, for the landscape is changing swiftly. An increasing number of private entities, including start-ups and universities, are entering the field of space activity, and more and more emerging space nations, in seeking to achieve their space ambitions, request membership of COPUOS to participate in its rule-making activities, consequently making its consensus process exponentially more complex.

Space technology progresses at rapid speed, and revolutionary, new space endeavours enter the scene, such as the deployment of large constellations of very small satellites, private human launches to the edge of space, and space resource mining on the moon or asteroids. The legal aspects of these new activities are not explicitly addressed in the treaties, and additional clarification and elaboration of the basic principles contained therein is needed.

Be that as it may, the UN space treaties remain fully applicable and valid even after 50 years: a small number of States ratify the space treaties each year, no State has ever withdrawn from them, there have been no violations of the main legal tenets of peaceful space cooperation, and amendments have never been proposed. Challenges posed by the new playing field can, to some extent, be addressed by means of national space legislation designed to keep private activities in line with the treaty provisions, as well as by bilateral or multilateral agreements. The risk, however, is that commercial interests, rather than global ones, may prevail.[127]

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126 *North Sea Continental Shelf* (*Germany v Denmark/Netherlands*) (Merits) [1969] ICJ Rep 3, 43–44; *Continental Shelf* (*Libyan Arab Jamahiriya v Malta*) (Merits) [1985] ICJ Rep 13, 29; *Case Concerning Military and Paramilitary Activities in and against Nicaragua* (*Nicaragua v USA*) (Merits) [1986] ICJ Rep 14, 97.

127 The recently adopted national legislations on commercial space mining in the United States and Luxembourg may serve as an example. Even though these laws were justified by the need to provide clarity and legal certainty to an emerging new industry, and both laws explicitly state the intent not to violate international space law, not all States approve this process. For an analysis, see for instance Tanja Masson-Zwaan and Neta Palkovitz, "Regulation of Space Resource Rights: Meeting the Needs of States and Private Parties" (2017) 35 Questions Intl Law 5.

Arguably, issues that affect humankind as a whole require global solutions to be agreed under the auspices of the UN. The long-term sustainability of space activities is a good example of an issue that affects all actors and that requires such a global solution, ideally in the form of a hard law instrument such as a treaty. Interestingly, however, this topic is not included on the agenda of the Legal Subcommittee of COPUOS but is dealt with in the Scientific and Technical Subcommittee.[128]

Furthermore, the process is cumbersome and fraught with political interests, and full agreement has not yet been reached. These points can be seen as further illustrations of the reluctance of States to accept new legally binding rules, and of their preference for soft-law solutions, even if the latter are still to have a global scope and are still to be achieved within COPUOS and under the auspices of the UN.[129]

5 Conclusion

To date, the UN has played a major role in elaborating an entirely new field of international law applicable to activities in the new dimension of outer space. These rules have stood the test of time and have ensured peaceful cooperation among States in outer space, despite a geopolitical setting characterized by extreme tension. Fifty years later, the scene has changed dramatically, both in terms of actors involved and emerging opportunities. In response, the UN must reassess its role in regulating this new phase of space activity.

The relevance of newly emerging topics is acknowledged by COPUOS, while they also gradually find their way onto the Legal Subcommittee. For instance, new items addressing space traffic management and small satellites,[130] and the governance of the use, exploration, and exploitation of

128 In 2010, the Working Group on the Long-term Sustainability of Outer Space Activities was established in the Scientific and Technical Subcommittee. Its objectives include identifying areas of concern, proposing measures to enhance sustainability, and producing voluntary guidelines to reduce risks to long-term sustainability. Thematic areas include, inter alia, space debris, space situational awareness, space weather and regulatory regimes, and guidance for actors. In June 2016 a first set of guidelines was agreed (COPUOS "Report of the Committee on the Peaceful Uses of Outer Space" (8 June 2016) A/71/20 Annex), and in 2018, consensus was reached on a preamble and nine additional guidelines; "Report of the Scientific and Technical Sub-committee on its Fifty-Fifth Session" (14 February 2018) A/AC.105/1167, Annex III; see also COPUOS "Report of the Committee on the Peaceful Uses of Outer Space" (20 June 2018) A/73/20. This notwithstanding, the Working Group was unable to refer the said preamble and guidelines to the General Assembly.

129 Jankowitsch (n 122) 10.

130 UNOOSA, "Space Traffic Management and Small Satellites: New Topics to Be Included in the United Nations International Space Law Discussions" (24 April 2015) UNIS/OS/449, http://www.unoosa.org/oosa/en/informationfor/media/2015-unis-os-449.html, accessed March 12, 2019.

space resources[131] were included in the agenda of the Legal Subcommittee, respectively in 2015 and 2016. It is also encouraging that COPUOS cooperates efficiently with other UN bodies, thus recognizing the interdisciplinary nature of space activities. By way of example, a booklet on "Guidance on Space Object Registration and Frequency Management for Small and Very Small Satellites"[132] was recently developed in cooperation with the International Telecommunication Union. Likewise, the Office of Outer Space Affairs (the secretariat of COPUOS) cooperates with the International Civil Aviation Organization with regard to the regulation of commercial space flight.[133]

Several States have expressed the concern that the role of the UN as a forum for space law-making may be reduced in the future, given, for instance, the emergence of national legislation addressing topics of universal concern.[134] A fruitful opportunity with which COPUOS reaffirmed its unique role in international space law-making arrived in the form of the "UNISPACE+50" session,[135] held in June 2018. This event was constructed around seven "Thematic Priorities," one of which was titled "Legal Regime of Outer Space and Global Space Governance: Current and Future Perspectives." Another indication that States are determined to uphold the pivotal role of the UN in the field of space law-making is the resolution adopted by the General Assembly, in the form of a "Declaration," on the fiftieth anniversary of the OST.[136] With this Declaration, the Member States of the UN "reaffirm the fundamental role played by the treaty" and are "convinced that it will continue to provide an indispensable framework for the conduct of outer space activities."[137]

131 UNIS, "Utilization of Space Resources to Be Included In United Nations International Space Law Discussions" (19 April 2016) UNIS/OS/464, http://www.unis.unvienna.org/unis/en/pressrels/2016/unisos464.html, accessed March 12, 2019..

132 UNOOSA & ITU, "Guidance on Space Object Registration and Frequency Management for Small and Very Small Satellites" (1 April 2015), http://www.unoosa.org/documents/pdf/psa/bsti/2015_Handout-on-Small-SatellitesE.pdf, accessed March 12, 2019.

133 ICAO, "Space Transportation", https://www4.icao.int/space, accessed March 12, 2019.

134 See, e.g., "Report of the Legal Sub-committee on its Fifty-Sixth Session" (18 April 2017) A/AC.105/1122 9, paras 44 and 45.

135 See UNOOSA, "Fifty Years since the First United Nations Conference on the Exploration and Peaceful Uses of Outer Space (1968–2018): UNISPACE+50", http://www.unoosa.org/oosa/en/ourwork/unispaceplus50/index.html, accessed March 12, 2019.

136 UNGA Res 72/78 (14 December 2017). Although the adoption of this resolution is positive, it was "hidden" in a package of 38 resolutions and 2 decisions, meaning that the UN General Assembly missed out on a rare opportunity to bring to the forefront the importance of the OST and space law as a whole; UN, "General Assembly Adopts 38 Resolutions, 2 Decisions from Fourth Committee, Including Texts on Decolonization, Israeli- Palestinian Issues" (*UN*, 7 December 2017), https://www.un.org/press/en/2017/ga11987.doc.htm, accessed March 12, 2019.

137 UNGA Res 72/78 (14 December 2017) (n 136) paras 4–5.

The UN will certainly continue to play a major role in the formulation of new international space law, although it might be in the form of soft law. Much will depend on the political will of States to reach consensus. The tendency toward increased adherence to the five UN space treaties, and the efforts of States to reach international agreement, even if non-legally binding, on new issues of universal interest are encouraging in this respect.

III Space Debris*

1 Introduction

The use and exploration of outer space suffer from a rapidly expanding amount of space debris. There is no formal definition of space debris, but generally it refers to man-made objects in orbit around the Earth that no longer serve a useful function, such as non-functional spacecraft, abandoned launch vehicle stages, mission-related debris, and fragmentation debris. Numerous objects of variable size, produced by collisions, explosions, or exhaustion of fuel, are rotating around the Earth and create dangers to space missions. Since the start of the space age in 1957, approximately 5,400 rocket launches have placed around 8,650 satellites into an orbit around the Earth, of which approximately 4,700 are still in space, but only around 1,800 are functioning.[1]

The drafters of the UN space treaties did not, and probably could not, foresee the dimensions this problem would take. They could not foresee the extent of congestion in some orbits which exponentially increases the risk of collisions, and they were unaware of the fact that even minuscule fragments of debris could cause great risks for space operations. As a consequence, the treaty provisions agreed in the 1960s are insufficient for the protection of the space environment and the missions that have been and will be undertaken to explore outer space and, eventually, exploit its resources.[2] There is a growing awareness that outer space must be kept clean and safe for future use.

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* *Introduction to Space Law*, T. Masson-Zwaan and M. Hofmann (Kluwer, 2019), pp. 109-119.

1 As of Jan. 2018. *See Latest facts & Figures*, at http://www.esa.int/Our_Activities/Operations/Space_Debris (all websites cited in this chapter were last accessed and verified on 10 Oct. 2018).

2 In 1983, K.H. Böckstiegel stated during a lecture at the UN in New York, 'The most important area of space law in my view will be for space lawyers to find adequate and effective rules for the protection of space environment […] Space environmental law will have to deal with two major risks: space debris and space pollution', cited by E. Vitt, *Die Gefahren der Weltraumtrümmer - neue Entwicklungen und Erkenntnisse*. 36/3 ZLW 249 (1987). *See also* K.H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space: State of the Law and Measures of Protection* (Heymanns 1990), L. Viikari, *The Environmental Element in Space Law Assessing the Present and Charting the Future* (Brill 2008), and various sessions on space debris and environmental aspects of space activities in the *Proceedings of the IISL Colloquia*, e.g. Brighton 1987 (AIAA 1988), Washington DC 1992 (AIAA 1993), Oslo 1995 (AIAA 1996), Hyderabad 2007 (AIAA 2008), Cape Town 2011 (Eleven 2012), and Beijing 2013 (Eleven 2014).

In addition to technical standards, clear legal rules for debris mitigation and remediation are needed.

This section will outline the characteristics of space debris, as well as relevant existing space law and the efforts and trends to address this problem. Such measures consist on the one hand of mitigation, i.e. not creating new debris, and on the other hand of remediation, i.e. cleaning up outer space by removing pieces of debris, including their legal ramifications.

2 Characteristics of Space Debris

As stated, debris can result from satellite fragmentations caused by explosions or collisions. Explosions may be deliberate, e.g. to test anti-satellite weapons in outer space, or accidental. The future major source of debris will probably be fragmentation resulting from collisions. A non-catastrophic collision between a space object and a piece of debris at ten kilometres per second will result in an ejected mass of 115 times the mass of the smaller object. This is how, for instance, a tiny paint chip could damage a window on the International Space Station in 2016.[3] Luckily, space debris has not yet resulted in catastrophic damage either in outer space or on Earth, but there have been two significant increases in the number of fragments. In January 2007, the Chinese *Feng Yun 1C* satellite was intercepted in an anti-satellite test generating around 3,500 objects that were large enough to be tracked and entered into a catalogue, and in February 2009, the first accidental collision between two intact objects (*Iridium 33* and *Cosmos 2251*) generated around 2,300 of such catalogued fragments.[4] The majority of the fragments of both these incidents remain in orbit for many years, creating a hazard for other satellites and the International Space Station and its inhabitants.

The problem lies in the fact that when space objects collide or explode, thousands of smaller particles are created, thus increasing the probability of further collisions. The need to increase awareness and manage the growing number of man-made objects in outer space, whether they are active or inactive, is clearly growing and this has led to the concept of Space Situational Awareness (SSA), which consists of debris surveillance mechanisms.[5]

3 *See* M.B. Griggs, *Tiny Debris Chipped A Window On The Space Station*, https://www.popsci.com/paint-chip-likely-caused-window-damage-on-space-station (12 May 2016). Similar damage occurred on other occasions, e.g. to a window of Space Shuttle *Challenger* in 1983.

4 International Academy of Astronautics, *IAA Situation Report on Space Debris*, at 13 (IAA 2016, hereafter referred to as *IAA Debris Report*).

5 For an overview of SSA capabilities, *ibid.* at 41–48.

It has been calculated that the current debris population consists around 21,000 catalogued objects.[6] To be identified, objects orbiting at four hundred kilometres must have a diameter of about five centimetres, and objects at one thousand kilometres must be at least ten centimetres in diameter to be seen. The US unclassified military Space Surveillance Network (SSN) has the most complete picture of the space environment.[7]

All objects will eventually be pulled back to Earth by friction with the Earth's atmosphere or by disturbances in the orbit. It may take millions of years before objects finally re-enter, depending on how close (or far) they are from the Earth. For example, an object which is situated in an orbit at one hundred kilometres above the Earth will return in a matter of days, whereas objects in the geostationary orbit at approximately 36,000 kilometres above the Earth will take millions of years. Around one third of debris is situated in Low Earth Orbit, up to around two thousand kilometres above the Earth's surface.

Re-entry events can be controlled or uncontrolled, depending on whether a de-orbit manoeuvre is performed. With the right selection of the target area, the re-entry risk associated with controlled re-entries can be reduced significantly. As objects re-enter, they usually burn up through the heat of friction with the Earth's atmosphere,[8] but large pieces may reach the ground and create danger to people and property. Some examples of re-entries include the uncontrolled re-entry of the US space laboratory *Skylab* in 1979 with a mass of 74,000 kg and the controlled re-entry of Russia's *Mir* Station in 2001 with a mass of 135000 kg. A more recent example is the uncontrolled re-entry of the Chinese Station *Tiangong* in April 2018.[9] Luckily, the largest part of Earth consists of water, so most re-entries occur far away from inhabited areas, but some objects occasionally reach the ground.[10] There are no known instances of bodily injury caused by space debris and no catastrophic damage has yet resulted from space debris.

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6 *See supra* n. 1. The number of debris objects estimated to be in orbit is 29,000 objects smaller than 10 cm, 750,000 objects between 1 and 10 cm, and 166 million objects between 1 mm and 1 cm, *ibid*.

7 *See* https://web.archive.org/web/20110817141444/http://www.stratcom.mil/factsheets/USSTRATCOM_Space_Control_and_Space_Surveillance/. The SSN detects, tracks, catalogues, and identifies artificial objects orbiting Earth, e.g. active/inactive satellites, spent rocket bodies, or fragmentation debris. The system is the responsibility of the Joint Functional Component Command for Space, part of the US Strategic Command (USSTRATCOM). SSA capabilities exist also in Europe, Russia, China, Japan, and India.

8 The atmosphere is of influence until 800-900 km above the Earth's surface.

9 *See IAA Debris Report*, *supra* n. 4 at 83, and J. Foust, *Tiangong-1 re-enters over South Pacific*, https://spacenews.com/tiangong-1-reenters-over-south-pacific/ (2 April 2018).

10 States must notify objects they discover on their territory to the UN, as required under Art. V of ARRA. A list of these is published at http://www.unoosa.org/oosa/en/treaty-implementation/arra-art-v/unlfd.html.

3 The Space Treaties

There is no internationally agreed legal definition of space debris, and the term is not mentioned in any of the treaties.[11] The Outer Space Treaty[12] stipulates in Article IX that States are to explore outer space, the Moon and other celestial bodies 'so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extra-terrestrial matter'; furthermore, it imposes a duty on State Parties to enter into consultations whenever harmful interference with the peaceful activities of another State may result from its activities. The Moon Agreement amplifies this provision by stating: 'In exploring and using the Moon, States Parties shall take measures to prevent the disruption of the existing balance of its environment whether by introducing adverse changes in that environment, by its harmful contamination through the introduction of extra-environmental matter or otherwise. States Parties shall also take measures to avoid harmfully affecting the environment of the Earth through the introduction of extra-terrestrial matter or otherwise.'[13]

Although Article IX of the Outer Space Treaty is often considered as the main basis for further rules on space debris mitigation and remediation, even if the article itself does not seem to impose a very strong legal obligation on States Parties, other provisions from the UN treaties are also relevant in the context of space debris. One of the main questions is whether space debris is still a 'space object' in the sense of the Liability Convention,[14] as the object is no longer functional or has exploded, and cannot be controlled. If the answer is negative, the Convention would not apply. However, Article I defines a space object as including the 'component parts of a space object as well as its launch vehicle and parts thereof' and this probably means that an inactive satellite, or a part of it, must still be considered a (component part of) a space object that remains the property of the State of registry,

11 For an analysis of the legal issues *see* F. Lyall & P. Larsen, *Space Law: A Treatise*, 245–280 (2nd ed., Routledge 2018) and L for a recentge 2018) andabilityLawAspects of Space Sctivities,Law: A treatise 6.f who would be liable. ct on the sustainability. Viikari, *Environmental Aspects of Space Activities* in F. von der Dunk & F. Tronchetti (eds.), *Handbook of Space Law* 717–770 (Edward Elgar 2015).

12 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 Dec. 1966, entered into force on 10 Oct. 1967, 610 UNTS 205 (hereafter also referred to as OST or Outer Space Treaty), *see* Annex 1 and analysis of this treaty in Ch.2

13 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, adopted on 5 Dec. 1979, entered into force on 11 July 1984, 1363 UNTS 3 (hereafter also referred to as MOON or Moon Agreement), *see* Annex 5 and the analysis of this treaty in Ch. 2; Art. 7 (1).

14 Convention on International Liability for Damage Caused by Space Objects, adopted on 29 Nov. 1971, entered into force on 1 Sept. 1972, 961 UNTS 187 (hereafter also referred to as LIAB or Liability Convention), *see* Annex 3 and the analysis of this treaty in Ch 2.

which retains jurisdiction and control.[15] The launching State of that object can therefore be held liable in case it causes damage under the Liability Convention. This liability is in theory eternal, since abandonment of ownership is not foreseen in space law, contrary to, for instance, the law of the sea. Should the damage occur in outer space as a result of a collision between two space objects or an explosion in outer space, then fault liability would apply.[16] And since the treaty does not specify the standard of fault, it may be hard to determine which State committed fault.

Another complicating factor is that an object may be so small that identification becomes difficult, if not impossible. The Registration Convention[17] attempts to solve the problem of identification by obliging launching States to register their space objects in a national register and to furnish, 'as soon as practicable', information concerning that object to the Secretary-General of the United Nations. But the information that has to be provided to register an object is not very detailed, and after the object has left its orbit, the State of registry must notify the Secretary-General thereof 'to the greatest extent feasible and as soon as practicable', which is also rather vague.[18] UN General Assembly resolution 62/101 of 17 December 2007 ('Recommendations on Enhancing the Practice of States and International Intergovernmental Organizations in Registering Space Objects')[19] attempts to remedy this by encouraging States to provide additional information on a change of status in operations, for instance when the space object is no longer functional, on the approximate date of decay or re-entry, and on the date and physical conditions of moving a space object to a disposal orbit. It also introduced ways to make the registration process more transparent.

Registration of an object does not have direct consequences for the determination of liability for damage caused by it.[20] Article VII of the Outer Space Treaty provides that the launching State is internationally liable for damage caused by its space object, and this provision was elaborated in the Liability Convention. But although several States can qualify as 'launching State', they must jointly determine which one of them will register the object.[21] If damage occurs, that State will be the most easily identifiable

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15 On the discussion of the definition of 'space object' and of 'debris,' *see* I.H.Ph. Diederiks-Verschoor, *Legal Aspects of Environmental Protection in Outer Space Regarding Debris*, in *Proceedings of the 30th IISL Colloquium, Brighton 1987*, 131–2134 (AIAA 1988).

16 LIAB, Art. III.

17 Convention on Registration of Objects Launched into Outer Space, adopted on 12 Nov. 1974, entered into force on 15 Sept. 1976, 1023 UNTS 15 (hereafter also referred to as REG or Registration Convention), *see* Annex 4 and the analysis of this treaty in Ch. 2; Art. II.

18 REG, Art. IV (1) and (3) respectively.

19 UN Res. 62/101, Recommendations on enhancing the practice of States and international intergovernmental organizations in registering space objects, UN Doc. A/RES/62/101 (17 Dec. 2007).

20 The OST stipulates in its Art. VII that the launching State is internationally liable. This provision was elaborated in LIAB.

21 REG, Art. II, (2).

launching State, and may be presented with a claim for compensation, but the other launching States are also, jointly and severally, liable.[22] A State that paid compensation may subsequently present a claim for indemnification to the other launching States.[23]

Some specific measures to mitigate and remediate the space debris problem will be analysed in the next sections.

4 Debris Mitigation

Debris mitigation measures can consist, for instance, of collision avoidance, passive protection, or end-of-mission disposal. It refers in general to any measures that can serve to moderate or alleviate the debris problem. Protective shielding and avoidance manoeuvers are examples of mitigating the risk of creating debris. In this section, several sub-topics will be addressed. First, non-binding guidelines will be discussed, with special focus on the UN debris mitigation guidelines of 2007. Then, two specific subjects will be highlighted, *viz.* efforts to create a system of space traffic management (STM), and the adoption of guidelines for the long-term sustainability of space activities (LTS).

4.1 Debris Mitigation Guidelines

There are several bodies that have adopted debris mitigation guidelines. The most important of these is the Inter-Agency Debris Coordination Committee (IADC), which adopted debris mitigation guidelines in 2002.[24] Other institutions have also adopted guidelines, such as the European Space Agency (ESA) or the space agencies of the USA, France and Japan. There is also a European Code of Conduct for Space Debris Mitigation, as well as an ISO Standard on space debris, and finally, several national space laws and regulations contain provisions concerning the mitigation of space debris. In 2014, UNCOPUOS published a useful 'Compendium of space debris mitigation standards adopted by States and international organizations', containing information about debris mitigation mechanisms (or the absence thereof) submitted by States and international organizations.[25]

The IADC guidelines served as the basis for further discussions in UNCOPUOS, and in 2007 the UN General Assembly endorsed the Space Debris Mitigation Guidelines that had previously been adopted by

22 LIAB, Art. V (l).

23 *Ibid.*, Art. V (2).

24 *See* Inter-agency Debris Coordination Committee, IADC Space Debris Mitigation Guidelines, rev. 1, IADC-02-01, https://www.iadc-online.org/ at 'documents' (Sept. 2007).

25 *Compendium of space debris mitigation standards adopted by States and international organizations*, *see* http://www.unoosa.org/oosa/en/ourwork/topics/space-debris/compendium.html. The collection is continuously updated by the UN Office for Outer Space Affairs.

UNCOPUOS.[26] The text explaining the background of the guidelines contains a definition of space debris: 'space debris is defined as all man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional'.

The seven guidelines are as follows:

- Limit debris released during normal operations;
- Minimize the potential for break-ups during operational phases;
- Limit the probability of accidental collision in orbit;
- Avoid intentional destruction and other harmful activities;
- Minimize potential for post-mission break-ups resulting from stored energy;
- Limit the long-term presence of spacecraft and launch vehicle orbital stages in the Low Earth orbit (LEO) region after the end of their mission; and
- Limit the long-term interference of spacecraft and launch vehicle orbital stages with the geosynchronous Earth orbit (GEO) region after the end of their mission.

The UN guidelines are not legally binding, but can be qualified as 'soft law'. However, States may decide to make them binding in their national legal order, by requiring private entities to comply with these guidelines as a condition for obtaining a license.

UN General Assembly resolution 68/75 of 11 December 2013 gives recommendations on national legislation relevant to the peaceful exploration and use of outer space.[27] It refers to space debris by noting 'the need to maintain the sustainable use of outer space, in particular by mitigating space debris, and to ensure the safety of space activities and minimize the potential harm to the environment', and recommends that States should make sure that space activities are carried out in a safe manner and do not lead to harmful interference with other space activities. In addition, they should verify the experience, expertise and technical qualifications of license applicants and could include safety and technical standards that are in line with the UNCOPUOS Space Debris Mitigation Guidelines.

Although these guidelines are not legally binding, their soft law character should not be underestimated, as they may evolve into international customary law with sufficient state practice and *opinio juris*, and thus become binding on States.[28] In addition, as stated earlier, national space legislation often includes an obligation for private entities to comply with the guidelines, thus making them binding under national law.

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26 UN Res. 62/217, International cooperation in the peaceful uses of outer space, UN Doc. A/RES/62/217, (22 Dec. 2007).

27 UN Res. 68/74, Recommendations on national legislation relevant to the peaceful exploration and use of outer space, UN Doc. A/RES/68/74 (11 Dec. 2013).

28 cf. Statute of the International Court of Justice, Art. 38.

4.2 Space Traffic Management

Efforts in the field of Space Traffic Management (STM), i.e. to create operational 'rules of the road' in a broad sense, can also help minimize space debris, because if operators observe clear rules of the road, the risk of collisions between space objects will significantly reduce.[29] STM has been defined as 'the set of regulatory rules to ensure safe access to outer space, safe operations in outer space and safe return from outer space'.[30] It has become urgent to address STM as a consequence of the increased use of outer space. Activities involving sub-orbital flights, space resource utilization and mega-constellations[31] will increase the risk of collisions generating debris, and pressure States to mitigate the risks of increasing congestion of outer space in order to ensure the safety of space operations and to preserve the space environment. One element of STM is SSA, which allows to detect, track and identify objects in outer space to protect space assets and to predict and prevent collisions. Another element of STM is the establishment of 'rules of the road' for space traffic, comparable to Air Traffic Management (ATM) in air law. This will allow space objects to reach, operate in and return from space in a safe manner and without interference. Having internationally agreed rules of the road will also facilitate the attribution of liability in case of a collision in outer space, which is subject to fault liability under Article III of the Liability Convention. Current international space law does not contain a precise standard of fault, and therefore it will be very difficult to prove. Traffic rules can help to set a standard of care and due diligence for space activities against which behaviour of space actors can be assessed in order to attribute fault.

It is encouraging that Space Traffic Management was added as a new item on the agenda of the Legal Subcommittee of UNCOPUOS in 2016 under the title 'General exchange of views on the legal aspects of space traffic management'. It was discussed for the first time in 2017, and the report states:

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29 Recently several major reports on STM were published, showing the relevance of the topic. The International Academy of Astronautics published its report on *Space Traffic Management: Towards a Roadmap for Implementation* (IAA 2018). This was a follow-up to an earlier report, the *Cosmic Study on Space Traffic Management* (IAA 2006).was 8). this s to eh the increasAA r report of 2008nternational Academy of Astronaytics, titled aking them binding under nationa NASA published the *Orbital Traffic Management Study: Final Report* (2016), and the German Aerospace Centre (DLR) published the *White Paper on the Implementation of a European Space Traffic Management System* (2017). *See* for an overview, C. Mihai Taiatu, *Space Traffic Management: Top Priority for Safety Operations*, Proceedings of the IISL 2017, 15–33 (Eleven 2018). *See also*, A. Soucek, Perspectives on Future Space Traffic Management, 10th UN Space Law Workshop (Vienna 2016), at http://www.unoosa.org/pdf/SLW2016/Panel1/3._Soucek_Future_perspectives_of_space_traffic_management_Soucek_final.pdf.

30 IAA Cosmic Study 2006, *supra* n. 29.

31 *See* for these activities respectively Ch. 6, 7 and 11.

> 'The Subcommittee noted that the space environment was becoming increasingly complex and congested, owing to the growing number of objects in outer space, the diversification of actors in outer space and the increase in space activities. It was noted that all of those factors increased the chances of potential collisions in outer space and that space traffic management could be considered in that context.'[32]

There was no agreement on the need for a multilateral approach to this problem, as some States preferred to pursue national solutions for the time being. The topic was again discussed at the Legal Subcommittee in 2018, but no concrete results were obtained. STM was considered to be closely connected to the topic of the long-term sustainability of space activities, which will be addressed in the next section.[33]

4.3 Long Term Sustainability of Space Activities

The UNCOPUOS Scientific and Technical Sub-Committee established a Working Group on the Long-term Sustainability of Space Activities (LTSSA) in 2010.[34] The task of the Working Group was to identify areas of concern, propose measures to enhance sustainability, and produce voluntary guidelines to reduce risks to the long-term sustainability of outer space activities. The long-term sustainability of outer space activities can be defined as

> 'The ability to maintain the conduct of space activities indefinitely into the future in a manner that realizes the objectives of equitable access to the benefits of the exploration and use of outer space for peaceful purposes, in order to meet the needs of the present generations while preserving the outer space environment for future generations'.[35]

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32 Report of the Legal Subcommittee on its fifty-sixth session, para. 188, UN Doc. A/AC.105/1122, 2017.

33 Report of the Legal Subcommittee on its fifty-seventh session, para. 211, UN Doc. A/AC.105/1177, 2018.

34 For an overview of the work of UNCOPUOS on the Long Term Sustainability of Space Activities, *see* http://www.unoosa.org/oosa/en/ourwork/topics/long-term-sustainability-of-outer-space-activities.html. In 2016, consensus was reached on 12 guidelines, *see* Report of the Committee on the Peaceful Uses of Outer Space, UN Doc. A/71/20, annex (28 June 2016). In 2018, consensus was reached on a preambular text and 9 more guidelines (*see* Report of the Scientific and Technical Subcommittee, UN Doc. A/AC.105/1167, Annex III (14 Feb. 2018)). *See generally*, *Guidelines for the long-term sustainability of outer space activities*, UN Doc. A/AC.105/L.315 (23 Feb. 2018). *See also*, *The UN COPUOS Guidelines on the Long-term Sustainability of Outer Space Activities, Secure World Foundation Fact Sheet* (Aug. 2018) available at https://swfound.org/media/206227/swf_un_copuos_lts_guidelines_fact_sheet_august_2018.pdf.

35 Conference room paper by the Chair of the Working Group on the Long-term Sustainability of Outer Space Activities, UN Doc. A/AC.105/2018/ CRP.20, para 5 (27 June 2018).

In order to carry out the work, four expert groups were established, as follows:

- Sustainable space utilization supporting sustainable development on Earth;
- Space debris, space operations, and tools to support collaborative space situational awareness;
- Space weather;
- Regulatory regimes and guidance for new actors in the space arena.

These groups delivered their reports in 2014, and the Working Group started developing draft guidelines based on their recommendations. A set of twelve guidelines was agreed in 2016, and the mandate of the group was extended until 2018. By June 2018, consensus was reached on another nine guidelines, resulting in a total of twenty-one guidelines and a preamble.[36]

The twenty-one non-legally binding, voluntary guidelines address the policy, regulatory, operational, safety, scientific, technical, international cooperation, and capacity-building aspects of space activities and are divided in four groups:

- Policy and regulatory framework for space activities (five guidelines);
- Safety of space operations (ten guidelines);
- International cooperation, capacity-building, and awareness (four guidelines);
- Scientific and technical research and development (two guidelines).

Consensus could not be reached on the remaining seven guidelines, and they are contained in a separate document.[37] Political tensions indeed marked the discussions throughout the mandate of the Working Group, and in the end, the Working Group did not manage to reach consensus on its final report, nor on how to refer the preamble and guidelines to the General Assembly or how to proceed on the remaining seven guidelines. As a consequence, the chair delivered his own report on the results of the last meeting.[38] In light of the abovementioned political tensions there was no consensus on the way forward, and discussions will likely continue at the next session of the Scientific and Technical Subcommittee in 2019. In any case, the guidelines must be seen as a living document which will be periodically reviewed, revised or added to, so that they may continue to ensure the long-term sustainability of outer space activities.

36 The preamble and the agreed guidelines are contained in doc. A/AC.105/2018/ CRP.20 (27 June 2018).

37 UN Doc. A/AC.105/2018/CRP.21 (27 June 2018).

38 Report of the Working Group on the Long-term Sustainability of Outer Space Activities, UN Doc. A/AC.105/2018/CRP.22/Rev.1 (28 June 2018).

5 Debris Remediation

Remediation means correcting a fault or a deficiency, and in terms of space debris it refers to removing objects that are no longer functional from outer space, to reduce the debris population. It has been calculated that catastrophic collisions will happen within decades, and that as a result, further catastrophic collisions will occur among the debris generated by those collisions. The IAA Space Debris Situation Report of 2016 observes: 'a self-contained collisional cascading process in the LEO regime may hence ultimately lead to a run-away situation (the so-called 'Kessler syndrome'), with no further possibility of control through human intervention. The only way to prevent the on-set of collisional cascading is to prevent collisions between large derelicts which may be enabled through active removal of mass from orbit.'[39]

Reducing the amount of debris in space, and thus the danger of collisions, by removing inactive satellites and other defunct objects from their orbits is a solution to the growing space debris problem that is gaining increased attention. This is what is called 'debris remediation' or 'active debris removal' (ADR) and can be realized in several ways, depending on the location of the debris. Objects in geostationary orbit can be boosted to a higher orbit which is not used, a sort of 'disposal orbit', whereas objects in Low Earth Orbit can be forced to re-enter the Earth's atmosphere and burn up in a controlled re-entry. Industry is developing many different technologies for ADR in LEO, which requires three steps: (1) rendezvous, (2) grapple or de-tumble, and (3) movement to a lower altitude. Grappling approaches include hooks, harpoons, nets, glue, foam, tentacles, and more.[40] ESA is planning an ADR mission named 'e-deorbit', aiming to capture and re-enter an ESA-owned derelict satellite.[41]

These techniques present many challenges in addition to technological ones. Cost could be a show-stopper, as it is unclear who would pay for clean-up missions if there is no legal obligation to do so.[42] Political will and national security issues will also be involved – after all, instead of cleaning up debris, a functioning satellite with sensitive dual-use technology could also be disabled or captured. There are also important legal aspects that may influence the feasibility of these techniques. Legal issues include

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39 *See IAA Debris Report*, *supra* n. 4 at 14.

40 For an overview *see*, *ibid.*, at 120–132.

41 *See* http://www.esa.int/Our_Activities/Space_Engineering_Technology/Clean_Space/e.Deorbit.

42 One solution could be the establishment of an 'International Outer Space Clean-Up Fund', to which each State would contribute according to its 'actual use' of the space 'environment'. This contribution could be based on the profit made or on a percentage of the cost involved. Part of the fund could be used for R&D in new materials that self-destruct harmlessly or can be recycled. *See* S. Ospina, *Outer Space: 'Common Heritage' or 'Common Junkyard' of Mankind?*, in *Proceedings of the 30th IISL Colloquium, Brighton 1987*, 228–233 (AIAA 1988).

questions of ownership, prior permission, liability, payment, security and insurance.[43] Removal missions could also cause damage to a third party, raising the question of who would be liable. An analogy with maritime law, especially the salvage and wreck removal conventions of the International Maritime Organization[44] can be drawn, although, as noted above, jurisdiction and ownership of a space object cannot be abandoned. It is likely that the first removal missions will focus on objects owned by the institution aiming at removing them; this will avoid questions about who should pay, who has jurisdiction and ownership, and will avoid national security issues. When the industry becomes more mature and the above questions have been solved by means of adequate regulation, a business model may develop. In addition to this newly emerging industry of ADR techniques and services, other new services and markets may evolve, such as on-orbit servicing (OOS). This may occur either simultaneously, before or after the emergence of ADR.

Both the ability to remove defunct objects, and to repair or refuel satellites while in orbit, thus postponing the need to launch new ones to replace them, will reduce the number of inactive satellites in outer space. Thus, both these developments will have a positive effect on the long-term sustainability of the outer space environment.

6 Conclusion

All space actors, whether they are major space players, emerging spacefaring nations, international organisations or private commercial entities, have a common interest in safeguarding outer space for future use. One of the major hurdles is the absence of explicit legal obligations to not create debris and to clean up existing debris. The creation of a new treaty on space debris to solve this is not very likely, but there are other solutions, e.g. in the form of 'soft law', to mitigate and remediate the space debris problem. Good examples are the UNCOPUOS guidelines on space debris mitigation and the resolution with recommendations on national space legislation. The work in the field of space traffic management and the long term sustainability of space activities are also important in this context, although the political tensions that have marked the latter would need to be resolved.

43 *See* e.g. J. Su, *Active Debris Removal: Potential Legal Barriers and Possible Ways Forward*, 9 J. E. Asia & Int'l L. 403 (2016) and B.C. Weeden, *Overview of the Legal and Policy Challenges of Orbital Debris Removal,* 27 Space Policy 38–43 (2011).

44 *See* http://www.imo.org/About/Conventions/ListOfConventions/Pages/Default.aspx.

IV Sustainability in Space*

Space is becoming more contested, congested, competitive, and contaminated. How to ensure the long-term sustainability of space activities, so present and future generations can use and explore it indefinitely?

When the space era started in the late 1950s, only the two superpowers, the USA and the USSR, were active and sustainability was not on the agenda; it was all about being first: a true 'space race'. During that time, the Outer Space Treaty[1] and several additional treaties were negotiated and adopted by consensus in a newly established UN permanent committee, the Committee on the Peaceful Uses of Outer Space, UNCOPUOS.[2] At that time, the Committee had around 20 Member States.

In 2021, this number has grown to around 100. In addition to the traditional space powers, newly aspiring space nations from around the globe have joined. Reaching consensus on binding law has become a 'mission impossible', and the last treaty, adopted in 1979, is often considered a failure because only 18 States have ratified it. An entirely new category of space actors has emerged as well, namely non-State actors such as large industries, start-ups, and even universities.

The variety of space activities has also grown. The application of space technology for communications, earth observation, and navigation are vital for our society and our economy. We cannot function without space, and space truly benefits humankind, as mandated by the Outer Space Treaty.

In terms of economic benefits, a 2020 report[3] estimated the global space economy at 385 billion USD. This includes government investments as well as commercial space and sets a record – despite the pandemic. Actually, the COVID-19 pandemic is a good example of how space can contribute to solving societal challenges. All space applications mentioned earlier – communications, navigation, and earth observation – play an essential role in combating COVID-19. Think of identification, management, and mitigation, and of response and recovery. Without the use of satellites all this

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* *Leiden Law Blog*, 19 January 2021, https://leidenlawblog.nl/articles/sustainability-in-space. *This blog is a summary transcript of the 2021 Meijers lecture,* https://www.youtube.com/watch?v=ZB3UIfVLL7M&feature=emb_logo

1 https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html.

2 https://www.unoosa.org/oosa/en/ourwork/copuos/index.html.

3 https://www.spacedaily.com/reports/Space_economy_valued_at_385B_in_2020_with_commercial_space_revenues_totaling_over_310B_999.html.

would be much harder. Space is indeed a major contributor to the realization of practically all of the UN Sustainable Development Goals[4], whether related to health, education, clean water, or climate.

But the increase in actors and activities has also led to an increasing number of problem areas. Our heavy reliance on space as a critical infrastructure means that space is becoming more and more 'congested, contested and competitive'. In addition, space is highly strategic, and although so far space has been kept free from weapons, military use has been a fact since the early days. Since there are no explicit rules in international space law that oblige States to clean up their defunct and fragmented satellites, the amount of space debris is steadily increasing, and so is the risk of harmful interference and collisions.

The company SpaceX of Elon Musk has been launching hundreds of tiny satellites into low earth orbit for a couple of years now, to build a large constellation named Starlink.[5] The aim is to provide broadband internet to all areas on the globe, which could be seen as beneficial for society. Ultimately, the plan is to have more than 40,000 Starlink satellites in orbit. To put this into context: there are currently about 6,000 satellites in space, 3,000 of which are still functioning. Projects like Starlink will result in a huge increase in space debris and collision risk. Moreover, they can have a detrimental effect on science. Astronomers are concerned by the light pollution they cause, affecting the so-called 'dark and quiet skies'.[6]

This shows that the increase in actors and activities also leads to conflicting interests, and this will have to be addressed by the authorities that authorise and supervise private commercial space activities. Indeed, the assessment of the environmental impact of a space activity is gradually becoming part and parcel of these authorisation processes.

By the latest estimations[7], there are currently some 130 million objects smaller than 1 cm in diameter in orbit. And those are the tricky ones, because they cannot be tracked. Because of the absence of binding international law in this field, there is a need to mitigate the impact of space debris by other measures. Over the years, various sets of guidelines have been adopted by the UN[8] and space agencies. These are often implemented in national law so that they also bind private actors. They provide for instance that States must avoid intentional breakups.

4 https://www.unoosa.org/oosa/en/ourwork/space4sdgs/index.html.
5 https://www.starlink.com/.
6 https://www.scientificamerican.com/article/spacexs-dark-satellites-are-still-too-bright-for-astronomers/.
7 https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers.
8 https://www.unoosa.org/pdf/publications/st_space_49E.pdf.

It is also important to start actively removing objects from orbit.[9] Technology solutions such as nets or harpoons are in the making, and further legal issues will need to be addressed. For example, prior approval from the owner of the debris will have to be sought, there may be a risk of damage to a third object, or national security issues could be at stake in case of abuse. It is also important to know what objects are where; this is called Space Situational Awareness and is carried out by various agencies. And Space Traffic Management rules will be needed, so-called 'rules of the road' for objects in orbit.

Creating less new debris, cleaning up existing debris, situational awareness, and space traffic management can all be placed in the broader context of the long-term sustainability of space activities. The international community is becoming increasingly aware that it is important to safeguard our ability to conduct space activities indefinitely into the future.[10] We must make sure that we can meet the needs of the present generations, while preserving the space environment for future generations. Only then can we achieve the stated objective of equitable access to the benefits of the exploration and use of outer space for peaceful purposes.

This topic of the long-term sustainability of space activities was placed on the agenda of UNCOPUOS more than a decade ago. The debates were very complex and highly politicised, but in the end, 21 UN guidelines were agreed and adopted in 2019.[11] States are now invited to abide by and implement these voluntary guidelines. Time will tell whether the international community will put its money where its mouth is, but I am hopeful that our awareness about the need for good stewardship will have a positive effect on our behaviour.

The International Institute of Air and Space Law[12] is actively involved in these discussions, both at national and international level. In 2020-2021, a study was conducted for the Dutch Radiocommunications Agency (*Agentschap Telecom*)[13] about whether the national legal framework for space activities needs to be adapted in view of the UN long-term sustainability guidelines, and the Institute is part of a large industry consortium for an EU H2020 project on Space Traffic Management, that kicked off this month.[14]

9 https://www.esa.int/Safety_Security/Clean_Space/ESA_commissions_world_s_first_space_debris_removal.

10 https://spacewatch.global/2021/01/spacewatchgl-opinion-space-sustainability-trends-2020-2021-and-beyond/.

11 https://www.unoosa.org/oosa/en/ourwork/topics/long-term-sustainability-of-outer-space-activities.html.

12 https://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-of-air-space-law.

13 https://www.agentschaptelecom.nl/onderwerpen/ruimtevaart.

14 https://cordis.europa.eu/project/id/101004208.

V Space Traffic Management: The Need of the Hour*

Abstract

This paper addresses the topic of Space Traffic Management from the perspective of the progressive development of international space law. It looks at current international space law and developments in the UN space law context and other fora, including industry initiatives. Although some elements relevant for STM can be found in the current regime, they do not provide a satisfactory legal basis for an STM regime. Traffic management regimes in air law and the law of the sea, specifically regarding international airspace and the high seas, may provide inspiration for the establishment of a global STM regime. In the absence of clarity at the level of international law, bottom-up approaches are emerging. The challenge will be to ensure that these approaches are compliant with the relevant principles of international space law, and eventually converge into a harmonised global STM regime that will preserve the safety and sustainability of outer space activities for the benefit of current and future stakeholders.

1 Introduction

A relatively new topic has gained the attention of the space law community, of which Professor Sergio Marchisio is a highly respected member and long-time friend. This topic is 'Space Traffic Management' (STM).[1] The term has been used in earlier writings on space law, but it is making the headlines more regularly now that outer space – and especially the region of Low Earth Orbit (LEO) – is becoming increasingly 'congested, contested

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* *Liber Amicorum Sergio Marchisio*, Giovanni Ardito et al. (eds.), (Editoriale Scientifica Napoli, 2022), pp. 1139-1154.

1 See e.g., P. LARSEN, *Space Traffic Management Standards*, in 83 *J. Air L. & Com.*, 2018, pp. 359-387; PJ BLOUNT, *Space traffic coordination: developing a framework for safety and security in satellite operations*, in *Space: Science & Technology*, 2021, https://doi.org/10.34133/2021/9830379; S. KAISER, Space Traffic Management: Not Just Air Traffic Management for Outer Space and More Than Data Analytics, in *2018 Proc. IISL*, 2019, pp. 301-315. K. HAVLIKOVA, *Legal Aspects Concerning Space Traffic Management*, in 46 *Air Sp. Law*, 2021, pp. 235–256; C. MIHAI TAIATU, *Space Traffic Management: top priority for safety operations*, in *2017 Proc. IISL*, 2018, pp. 15-33. See also T. MASSON-ZWAAN and M. HOFMANN, *Introduction to Space Law*, 2019, ch. 8, specifically pp. 115 ff.

and competitive'.[2] The topic of STM has been adopted as an official agenda item by the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) in 2015, demonstrating the need, and desire, for international coordination among States.[3]

Despite this growing awareness about the importance of the topic, the term STM is shrouded in vagueness; indeed, so far, no internationally agreed definition of STM exists. The most well-known ones are those used in the 2006 study of the International Academy of Astronautics (IAA)[4], and in the European Space Policy Institute (ESPI) report of 2020.[5] This paper is based on those definitions, which read as follows:[6]

> IAA: 'Space traffic management means the set of technical and regulatory provisions for promoting safe access into outer space, operations in outer space and return from outer space to Earth free from physical or radio-frequency interference'.
>
> ESPI: 'Space Traffic Management is an organisational and operational concept that involves a set of complementary means and measures to enhance the safety of on-orbit operations and to safeguard the long-term sustainability of the space operating environment'.

The growth of private commercial space activities plays a large part in the increased relevance of STM. Activities such as commercial Earth observation, large constellations of small satellites, space resource utilisation and suborbital flights create challenges for the existing regulatory framework, which was shaped by the initial two space powers at a time when space activities were mainly carried out by States. Issues of congestion, increased risk of collisions, competing stakeholders' interests and a growing population of debris are now the order of the day. The changes brought about by the commercialisation of space activities and the increasing participation of private actors contribute to the need to track the presence and movement of an ever-larger number of active and inactive objects in outer space.

In addition to this trend of privatisation and commercialisation, another factor that affects the current space playing field is that many new States are aspiring to become space powers. On the one hand this creates a need for capacity building to ensure that they become responsible space actors, while on the other hand it implies that reaching consensus in UNCOPUOS,

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2 This term was first used at the Sixty-eighth meeting of the General Assembly, First Committee, 25 Oct. 2013, see https://www.un.org/press/en/2013/gadis3487.doc.htm.

3 This growing interest is further exemplified by an ongoing EU study, Spaceways, funded under the EU H2020 research and innovation program, see www.spaceways-h2020.eu.

4 IAA, *Cosmic Study on Space Traffic Management*, 2006.

5 ESPI, *Towards a European Approach to Space Traffic Management*, Report 71, 2020. Available at https://espi.or.at/publications/espi-public-reports/category/2-public-espi-reports.

6 In addition, see US, *Space Policy Directive-3, National Space Traffic Management Policy*, 2018. Available at https://trumpwhitehouse.archives.gov/presidential-actions/space-policy-directive-3-national-space-traffic-management-policy/.

which has been the preferred decision-making mechanism since the start of the space era, is becoming increasingly difficult. This was seen during the adoption of the UN Long-Term Sustainability (LTS) guidelines in 2019, which took close to ten years.[7] Reaching international consensus on an STM regime may well face the same difficulties, but this does not affect the urgency of the topic.

2 Analogies

The fields of air law and maritime law contain regimes to manage traffic, which may to some extent be helpful in designing a traffic management regime for space. Although analogies are never perfect because situations and circumstances differ, they can still be useful. For this reason, the following sections address air law and the law of the sea, with a focus on traffic management in international airspace and in international waters, which are areas outside national sovereignty, like outer space.

2.1 Air Law

The Convention on International Civil Aviation, also known as the Chicago Convention, established the International Civil Aviation Organisation (ICAO), an international intergovernmental organisation.[8] The Chicago Convention is considered as the foundation for safety in flying, and foresees a common air navigation system at global level, with services being provided by States.

The Convention is supplemented by nineteen Annexes containing Standards and Recommended Practices (SARPs). Annexes 2 and 11 are most relevant for the topic of STM; they concern the Rules of the Air and Air Traffic Services respectively. Member States must implement SARPs at national level, and Article 38 of the Convention provides that States must notify differences in the event of non-implementation. In combination with the Convention, SARPs provide for a flexible and up-to-date legal framework for international civil aviation.

Article 28(a) of the Chicago Convention addresses air navigation facilities and standard systems. It provides that States, as far as they may find practicable, must provide airports, radio services, meteorological services and other air navigation facilities that would facilitate international air navigation. States fulfil this obligation by means of national legislation. The measures taken by States must conform with SARPs. A State can fulfil this obligation directly or delegate it to a private operator within its territory or in a neighbouring State.

7 See *infra*, sec. 3.5.

8 ICAO Doc 7300/9, Convention on International Civil Aviation, Ninth Edition, 2006, www.icao.int/publications/Documents/7300_cons.pdf.

The provisions of Annex 2 and Annex 11 apply without exception over the high seas. Annex 2 on Rules of the Air addresses, amongst other, the avoidance of collisions, including rules for proximity, right-of-way, landing, surface movement of aircraft, operation on and in the vicinity of an aerodrome, and others. Annex 11 on Air Traffic Services makes a distinction between air traffic control services, flight information services and alerting services. States must determine the territories over which they have jurisdiction and the portions of the airspace and aerodromes where air traffic services will be provided.

In addition to this international system, there are also regulations at the level of the European Union (EU). The European rules of the air are known as Standardised European Rules of the Air (SERA).[9] They are based on the ICAO SARPs.

Contrary to air law, space law merely lays down general principles for the behaviour of States in outer space.[10] Likewise, there is no international organisation comparable to ICAO that governs the safety of space activities. UNCOPUOS is a permanent committee of the UN and has no legislative capability like ICAO and has neither the capability nor the capacity to regulate and oversee the safety of spaceflight like ICAO does for aviation.

2.2 Law of the Sea

An analogy can also be drawn between STM and sea traffic management, to the extent that the high seas, like outer space, are outside the national sovereignty of States, and that traffic coordination is equally essential to mitigate collision risks at sea. In this respect, the UN Convention on the Law of the Saw (UNCLOS)[11] and the framework of the International Maritime Organisation (IMO)[12] are relevant.

The UNCLOS regime distinguishes between territorial sea and international waters. A particularity is the existence of the Exclusive Economic Zone (EEZ), which extends up to 200 nautical miles beyond the territorial sea. According to Article 56 UNCLOS, the coastal State has sovereignty over the EEZ as far as natural resources are concerned, and jurisdiction over

9 Regulation (EU) No. 923/2012 of 26 September 2012 laying down the common rules of the air and operational provisions regarding services and procedures in air navigation and amending Implementing Regulation (EU) No. 1035/2011 and Regulation (EC) No. 1265/2007, (EC) No. 1794/2006, (EC) No 730/2006, (EC) No. 1033/2006 and (EU) No. 255/2010.

10 See *infra*, sec. 3.3.

11 United Nations Convention on the Law of the Sea, concluded at Montego Bay on 10 December 1982.

12 E.g., International Convention for the Safety of Life at Sea (SOLAS), 1974 which refers to Vessel Traffic Services and creates guidelines, see https://www.imo.org/en/OurWork/Safety/Pages/VesselTrafficServices.aspx; see also: Convention on the International Regulations for Preventing Collisions at Sea (COLREG), 1972; International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978.

artificial islands, marine scientific research, and environmental protection. The need to navigate safely and avoid collisions is a major concern in the maritime environment, where traffic is essential for, among others, transportation and commerce. Sea traffic management mechanisms encourage the dissemination of information with other vessels. However, there is no international sea traffic management regime. Instead, Vessel Traffic Services (VTS) are provided by the most proximate State, due to the presence of harbours and ports, based on national, regional and international guidelines, norms and standards. In addition to collision avoidance and sustainability, sea traffic management aims at preserving the integrity of communication, trade, and commerce.

At the EU level several initiatives exist as well, such as the H2020 projects EfficienSea[13] and ACCSEAS.[14]

As space traffic and the reliance on space capabilities increase, the need for STM can be expected to grow to resemble the maritime regime and address other factors in addition to collision avoidance and preserving sustainability.

After having summarised the regimes of traffic management in international airspace and in international waters, the time has come to see whether space law contains a similar regime, or at least elements on which such a regime could be based.

3 International Space Law

The existing international legal regime for space activities can be found within the space law framework of the United Nations (UN).[15] International space law primarily comprises of five treaties adopted by UNCOPUOS. The Outer Space Treaty (OST) was the first international agreement to ever regulate space activities. It was followed by the Rescue and Return Agreement (ARRA),[16] the Liability Convention (LIAB),[17] the Registration Convention (REG),[18] and the Moon Agreement (MA).[19]

13 http://www.efficiensea.org/.

14 https://www.iala-aism.org/technical/e-nav-testbeds/accseas/.

15 In addition, regimes and initiatives of other international bodies like the International Telecommunication Union (ITU) and the Conference on Disarmament (CD) are relevant, as well as those of regional bodies that deal with matters connected to STM, i.e., the European Union (EU) and the European Space Agency (ESA). However, they cannot be addressed in the limited scope of this paper.

16 Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 1968, 672 UNTS 179.

17 Convention on the International Liability for Damage caused by Space Objects, 1972, 961 UNTS 187.

18 Convention on the Registration of Objects Launched into Outer Space, 1974, 1023 UNTS 15.

19 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 1979, 1363 UNTS 3.

The UN space treaties do not contain any explicit reference to STM. They contain principles and general provisions that govern the conduct of States in the exploration and use of outer space. Several of these provisions are relevant to STM, such as those addressing responsibility for national space activities, liability of the launching State, registration and jurisdiction over space objects, and the avoidance of harmful interference. These can be used as foundation for an STM regime and will be addressed in the next paragraphs.

3.1 State Responsibility

According to Article VI OST, a State is internationally responsible for the activities of its nationals in outer space, which should be authorised and continuously supervised. The responsibility of States extends to the activities that are carried out by governmental as well as non-governmental entities. Article VI forms the basis for the adoption of national space laws that lay down the conditions under which a State authorises the activities of its nationals. Furthermore, it calls upon States to maintain an overview of the progress of their national activities, from the launch to the end of the mission, as well as potential changes, including the position and trajectory of the launched object.

These elements are relevant for the adoption of STM guidelines, which, if not legally binding at international law, might be implemented at national level.

3.2 State Liability

Article VII OST creates international liability for a State for damage caused by its space activities. The liability provision of the OST is further elaborated in the LIAB. According to Article VII OST, a State can be held liable if it qualifies as a launching State, i.e., if it launches or procures the launching of an object into outer space or if its territory or facility are used for the launch. Once a State qualifies as a launching State, it will always remain a launching State, and can be held liable even in the case of transfer of ownership in orbit.

Article II LIAB provides for absolute liability in case of a damage caused by space objects on the surface of the Earth or to an aircraft in flight, while Article III LIAB provides for fault liability if damage is caused 'elsewhere than on the surface of the Earth', i.e., in outer space. Fault is not easy to prove, as it is not defined by the LIAB and may depend on applicable national law. The prospect of 'eternal' liability and the uncertainties surrounding the concept of fault may be convincing arguments for the establishment of an STM regime; after all, non-compliance with such a regime may well be seen as an element of fault, while compliance with such a regime may help to argue the absence of fault.

3.3 Registration and Jurisdiction

According to Article VIII OST the State Party on whose registry an object is launched into outer space shall retain jurisdiction and control over that object. Moreover, (one of) the launching State(s) must furnish basic information for the UN registry, as well as a national registry. The REG specifies the information that must be provided and calls for States Parties, especially those with monitoring and tracking facilities, to respond, under equitable and reasonable conditions, to requests for identification of space objects that caused damage. States should also share preliminary information regarding their missions with the international community by furnishing registration information to the UN Secretary-General. However, the treaties do not specify when an object should be registered, which may result in untimely registration and an inaccurate record.

Furthermore, changes in the orbital parameters of an object are not required to be registered. Jurisdiction and control over space object must be exercised throughout their lifetime. This may be particularly challenging for small, non-manoeuvrable satellites or non-functioning space objects, hence the relevance of registration in the context of STM.

3.4 Harmful Interference

During their activities in outer space, States must refrain from causing harmful interference with the activities of other States. Article IX OST obliges States to pay due regard to the corresponding interests of other States, and to enter into international consultations if their activities could cause harmful interference.

This provision is generally seen as the legal basis for additional, non-legally binding instruments adopted by UNCOPUOS or other bodies in the field of space debris mitigation and the long-term sustainability of space activities, which are addressed in the next section. It will also likely serve as an important legal basis for a future STM regime.

3.5 Guidelines

In addition to the treaties, UNCOPUOS has adopted two sets of guidelines that are relevant in the context of STM, viz., the Space Debris Mitigation Guidelines of 2007[20] and the Long-Term Sustainability Guidelines of 2019.[21]

20 Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, https://www.unoosa.org/pdf/publications/st_space_49E.pdf, endorsed in UN Doc. A/RES/62/217 (22 Dec. 2007).

21 UNOOSA, Guidelines for the Long-term Sustainability of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space, 2021, www.unoosa.org/documents/pdf/PromotingSpaceSustainability/Publication-_Final_English_version.pdf

For the latter, especially the ten guidelines in category 'B' on the 'Safety of Space Operations' can be associated with elements for STM.

Both these sets of guidelines are not legally binding; they can be qualified as 'soft law'. But this soft law character should not be underestimated, as the guidelines may evolve into international customary law with sufficient State practice and *opinio juris*, and thus become binding on all States.

Furthermore, States may decide to make them binding in their national legal order, by requiring private entities to comply with them as a condition for obtaining a license.

4 Developments in UNCOPUOS

Although the current legal framework as contained in the treaties contains certain elements that are relevant for STM, it does not provide a clear legal basis for establishing an STM regime. Likewise, the sets of guidelines for debris mitigation and LTS are relevant, but not specific enough to serve as basis for an STM regime. Thus, it is not surprising that the Legal Subcommittee of UNCOPUOS started to consider the matter in 2015 and adopted an agenda item titled 'General exchange of views on the legal aspects of space traffic management' as a single issue/item for discussion. The item has been on the table for several years now, but no concrete results have been obtained yet. As mentioned in section 3.1, this is not surprising in view of the difficulty of reaching consensus in a large and divergent group of States, combined with the general reluctance of States to enter into new legally binding agreements.

In order to reflect the general orientation of the debate, the deliberations about STM in the draft report of the session of the Legal Subcommittee of 2021 are briefly highlighted below.[22]

At that session, which was conducted mostly virtually due to COVID-19, the members of UNCOPUOS noted that the outer space environment was becoming increasingly complex and congested, owing to the growing number of objects in outer space, the diversification of actors in outer space and the increase in space activities, and it considered that 'space traffic management *could* be considered in that context' (emphasis added). It took note of several measures that could be undertaken at national and international levels to improve the safety and sustainability of spaceflight, such as:

> 'Collision avoidance, re-entry and fragmentation services through the development and operation of space surveillance and tracking capabilities; the issuance of conjunction warnings as a public service; the registration of space objects; pre-launch notifications; the reporting of annual launch plans; space debris removal techniques; international coordination efforts through ITU to manage radio fre-

22 Report of the Legal Subcommittee on its sixtieth session, held in Vienna from 31 May to 11 June 2021, UN Doc A/AC.105/1243, para. 192 ff.

> quencies and geostationary orbits; the transfer of responsibilities for space flight safety support between government departments to enable access to a broader range of data and analyses through an open-architecture data repository; a policy on space traffic management rule-making; a report on requirements for on-orbit servicing; an international symposium on ensuring the stable use of outer space that focused on space traffic management and on-orbit servicing; and a space traffic management conference at the European level.'[23]

Several delegations made a connection between STM and LTS, noting that without the development of an effective STM system through regulation and monitoring, the use of outer space by future generations could not be ensured. The importance of adopting a uniform definition of STM was also raised.

The need for a pragmatic approach was raised, excluding, for the time being, the development of binding rules. The relevance of capacity-building to ensure that emerging space actors can efficiently participate in discussions on the topic was also brought up.

Lastly, delegates observed that the following elements should be taken into account in developing an international STM framework: (i) increased requirements for information-sharing, in particular through SSA programmes; (ii) incentives for international cooperation and capacity-building; (iii) common operating rules and safety standards; (iv) notification mechanisms, in particular for launches, orbital manoeuvres and re-entries; (v) right-of-way rules; (vi) specific safety-related provisions aimed at increasing transparency and trust between States; (vii) provisions for the mitigation and disposal of space debris; and (viii) environmental regulations.

It remains to be seen when a concrete outcome can be expected from these debates; as noted before, the adoption of the LTS guidelines took nearly ten years. In the meantime, other governmental and non-governmental actors at national and/or regional level will continue to move forward, and their decisions will certainly influence the international debate. The next section will elaborate on several non-governmental initiatives.

5 Other Developments

In the absence of progress at the international level, governmental and non-governmental actors who are facing a direct and real need for an STM regime are taking action. These initiatives result in the adoption of standards, norms, policies, and best practices which will no doubt influence an eventual international agreement. Coordination at international level is important to ensure that they are in line with international legal principles as agreed among States. Several noteworthy initiatives are addressed below.

23 Ibid, para 195.

5.1 Satellite Industry Association

The Satellite Industry Association (SIA)[24] is a US trade association representing US satellite operators, service providers, manufacturers, launch services providers and ground equipment suppliers. It closely collaborates with space agencies and regulatory bodies to implement regulations, and with the space industry to foster industrial initiatives and the adoption of best practices for the sustainability of space endeavours. In 2020 SIA published a White Paper on 'The Future of Space and Space Traffic Coordination and Management'.[25] The association observes an increased need for a futureproof space traffic coordination and management (STCM) regime, and that the current framework of space law requires review and, in some cases, revision.

The paper cites six topics as the most important STCM issues, as follows:

- Timeliness: current SSA services are insufficient to ensure space safety and sustainability of the space environment.
- Orbital accuracies: the accuracy of datasets needs to be improved; operators often rely on very conservative assumptions for decisions to implement collision avoidance decisions, resulting in a flood of warnings.
- Commercial SSA and STCM services: commercial services are needed to augment current governmental services.
- Tracking and advanced SSA analytics: diverse SSA tracking networks and sensor types are needed, and their data must be brought together using modern data fusion engines and analytics.
- Open Architecture Data Repository (OADR): satellite operators have been proactively contributing data on their spacecraft, and that model must now be extended across the global space operator population under a robust STCM enterprise.
- Availability of information: SSA and STCM data must be made readily available to all space operators, commercial or governmental, regardless of mission, altitude or nationality.

The paper then provides four recommendations, as follows:

- Action and funding: the US government should act now to implement a modern STCM environment and create a US-developed cutting-edge space sustainability model.
- No imposition of specific technologies: innovation must be allowed to ensure the most cost-efficient and effective technologies.

24 https://sia.org/.

25 https://sia.org/wp-content/uploads/2020/09/REVISED-White-Paper20-STCM-Sept-23rd-V1.0.pdf.

– Government to encourage best practices: commercial space industry participation and support is needed to ensure wide-spread adoption of space safety practices and to reduce unnecessary and burdensome regulations.
– Endeavour to meet global needs: US and international space activities must be included, which requires leadership of the US government, commercial stakeholders and like-minded space-faring counterparts.

The White Paper demonstrates the commitment of the US space industry to invest in STM, even without binding regulations in place.

5.2 Space Data Association

Established in 2009, the Space Data Association (SDA) is an international organisation that aims to enhance safety of flight via sharing of operational data and promotion of best practices across the industry. Its membership includes the world's major satellite communications companies, such as EUTELSAT, INTELSAT, SES and INMARSAT. The SDA works to improve the accuracy and timeliness of collision warning notifications, and collaborates with all interested entities to help define the next generation of STM systems and capabilities.[26] Its objective is to promote the quick communication and exchange of adequate information between space operators operating in GSO to avoid collisions and the creation of space debris.

A partnership between SDA and Analytical Graphics, Inc., a US. technology company, led to the creation of the Space Data Center, a platform for collecting information related to space objects communicated by space operators and an anti-collision alert system, considered to be more practicable than data from the Combined Space Operations Center (CSpOC).

5.3 Space Safety Coalition

The Space Safety Coalition was established in 2019 and adopted 'Best Practices for the Sustainability of Space Operations', applicable to all spacecraft regardless of physical size, orbital regime or constellation size.[27] Building upon previous initiatives including the UN space debris mitigation guidelines and the standards of the International Organization for Standardization (ISO) and the Consultative Committee for Space Data Systems (CCSDS), the five Best Practices provide the following:

– Spacecraft owners, operators and stakeholders should exchange information relevant to safety-of-flight and collision avoidance. Direct reference is made here to SSA and STM.

26 https://www.space-data.org/sda/
27 https://spacesafety.org.

- In selecting launch service providers, space operators should consider the sustainability of the space environment.
- Mission and constellation designers and spacecraft operators should make space safety a priority when designing architectures and operations concepts for individual spacecraft, constellations and/or fleets of spacecraft.
- Spacecraft designers and operators should design spacecraft that meet a number of best practices. Nine items are listed, including the requirement that spacecraft should strive for a disposal process providing a probability of successful disposal of 95%, that spacecraft designs should consider including technologies and features that facilitate capture and deorbit, and that spacecraft should be designed to be reliably trackable from the ground using passive tracking means.
- Spacecraft operators should adopt space operations concepts that enhance sustainability of the space environment.

So far, the Best Practices have been endorsed by nearly fifty entities from around the world, ranging from manufacturers, operators, insurance companies, consultancies and launch service providers to associations and other non-governmental entities, who undertake to promote and strive to implement them within their respective organisations.

5.4 ASD-Eurospace

Eurospace is the trade association of the European Space Industry. In 2004, it became the Space Group of the Aerospace and Defence Industries Association of Europe (ASD).[28] In February 2021, the group published a position paper titled 'Space Traffic Management (STM): An Opportunity to Seize for the European Space Sector – EUROSPACE Manifesto for a European Global Answer on STM'.[29]

The paper observes that current initiatives and decisions regarding STM, e.g., in the US, are likely to create a challenging environment for European actors, as they could have a significant impact on the sustainability of Europe's autonomous access to space and its use because of dependency on the US and the need to comply with guidelines and best practices defined by and for US actors. Furthermore, they could affect the competitiveness of the European space manufacturing industry.

The paper urges the EU to be at the forefront of the discussions about STM and to be proactive, it argues that a European approach could be seen as more neutral than the US approach in the global community. Recommendations for specific actions include the coordination of EU Member States' national efforts, the creation of an internal European market for SSA, the

28 https://eurospace.org.

29 https://eurospace.org/wp-content/uploads/2021/03/eurospace-pp_space-traffic-management_opportunity-for-europe_final_february-2021.pdf.

creation of funded programme lines for STM, and the promotion of a strong industrial involvement in the EU Space Surveillance and Tracking (SST) Support Framework, established by the EU in 2014.[30]

The Eurospace paper demonstrates that the European space industry sector is concerned about US dominance in the field of STM and wants Europe to become actively engaged in the process towards the creation of a global STM regime.

5.5 World Economic Forum

A last interesting development to mention here is a system, developed by the World Economic Forum (WEF) in cooperation with several partners, to rate the sustainability of space systems. The 'Space Sustainability Rating' (SSR) was first presented in 2019, and could become a metric to know how well a satellite or satellite system could avoid the creation of space debris. A successful SSR could result in encouraging more responsible behaviour in outer space, including the activity of decommissioning satellites and actively removing space debris. A good rating could spotlight missions that contribute positively to space environment, while a bad rating could influence insurance premiums.[31] The SSR will use factors such as data sharing, choice of orbit, measures taken to avoid collisions and plans to de-orbit satellites at the end of their mission, and how easily satellites can be detected and identified from the ground, to score the sustainability of satellite operators.[32]

In June 2021 the École Polytechnique Fédérale de Lausanne (EPFL) Space Center (eSpace) was selected to host this 'Space Sustainability Rating' (SSR) initiative.[33] The Center will lead the SSR towards an operational system as the next step of the initiative which started several years ago.

6 Conclusions

The space landscape has changed dramatically in recent years, both in terms of activities and in terms of actors. These changes are creating new challenges that need to be addressed to maintain space safe and sustainable.

The current international UN legal framework governing space activities does not include provisions specifically related to STM, neither in the treaties, nor in the subsequent soft law instruments. However, the treaties do contain principles about, e.g., the supervision of space activities,

30 https://www.eusst.eu/.

31 https://www.weforum.org/projects/space-sustainability-rating.

32 ESA, *Space sustainability rating to shine light on debris problem*, 17 June 2021, www.esa.int/Safety_Security/Space_Debris/Space_sustainability_rating_to_shine_light_on_debris_problem.

33 https://espace.epfl.ch/research/space-sustainability-rating.

avoidance of harmful interference and liability for damage, whereas the non-binding instruments address ways to mitigate space debris and to ensure the long-term sustainability of space activities. All these hard- and soft law provisions are relevant for the future adoption of a global STM framework, and, read together, can be interpreted as an incentive for States, international organisations and private entities to perform their activities in outer space in a cooperative, safe and sustainable manner.

In terms of State responsibility, national law can implement STM guidelines agreed at international level. In terms of liability for damage, the adoption of a global STM regime will likely facilitate the attribution of fault in case of damage occurring in outer space. In terms of registration, what is lacking is a clear obligation to share timely information about space missions. A future STM regime will therefore need to include relevant capabilities and requirements for adequate space situational awareness. But the 'eternal' duty of the State of registry to exercise jurisdiction and control may convince States of the need for agreeing on an STM regime. Lastly, in terms of due regard for the activities of other States, the adoption of an STM regime will facilitate the avoidance of harmful interference.

Current developments in various non-governmental fora, in addition to various national and regional developments, such as in the USA and the EU, can be useful in paving the way for international agreement. It must be ascertained that these initiatives are compliant with the principles of international space law. Hence, coordination between these actors and UNCOPUOS is of great importance, so that the work of both groups converges into a workable, efficient and strong global STM regime. Non-State actors should be allowed and encouraged to provide input to the debate in UNCOPUOS. Hopefully the Committee will see the merit of taking these developments into consideration, as they emanate from those who are directly affected and are likely to present pragmatic solutions for keeping outer space safe and sustainable for current and future generations.

VI Starlink or Stargazing: Will Commerce Outshine Science?*

Abstract

The ever-growing trend in commercialization and privatization of space activities means that it is becoming more and more difficult for national authorities to find a balance between the valid but potentially conflicting interests of various stakeholders. Low Earth Orbit is becoming more and more contested and congested. One of the consequences is a sharp increase of interference by (commercial) large satellite constellations with (publicly funded) astronomy.

This chapter addresses the potential conflict between space science and space commerce and discusses ways to solve it. It argues that some of the early suggestions emanating from the astronomical community are not legally sound, and that focus should instead be shifted to more viable legal arguments to ensure a balanced consideration of the interests of all legitimate stakeholders in the exploration and use of outer space. It urges the United States Government and the United Nations Committee on the Peaceful Uses of Outer Space to acknowledge their responsibility, before the dark skies and accessible internet are lost for future generations.

1 The Problem and the Outer Space Treaty

Everyone has heard about pollution of the Earth, seas and oceans by plastics, chemicals, and other sorts of waste. Action to address such pollution is undertaken at various levels by governments, politicians, industry, and civil society. Most are also familiar with pollution caused by city lights in built up areas.

A lesser-known phenomenon is that of pollution of the night skies from outer space. Yet, there is a growing concern that the observation of stars and planets by professional and amateur astronomers, both in terms of ground-based optical astronomy and radioastronomy, will be severely hampered by the huge number of artificial satellites in outer space. Optical astronomy suffers from the 'light pollution' caused by the reflection of the Sun on these satellites, whereas radio astronomy suffers from the radio interference they cause.

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* *Reclaiming Space: Progressive and Multicultural Visions of Space Exploration*, James Schwartz, Linda Billings and Erika Nesvold (eds.), *forthcoming*, 2023

Several private space companies plan to launch extremely large numbers of small satellites into Low Earth Orbit (LEO) to provide communications services all over the globe. These projects are commonly referred to as mega-constellations, or large constellations.[1] The four main constellations known in detail as of mid 2021 would comprise more than 50,000 satellites; they are:

– SpaceX, with its Starlink constellation (30,000 satellites),
– Amazon, with its Kuiper constellation (7774 satellites),
– OneWeb constellation (6372 satellites), and
– China with its Guangwang constellation (12992 satellites).[2]

By mid-2021, SpaceX had already launched some 1700 Starlink satellites. That is around 50% of all active satellites that are currently in orbit.[3] And that is not all. In November 2021, several companies filed requests with the US Federal Communications Commission (FCC) for new or expanded broadband networks, asking for approval of nearly 38,000 satellites. The largest requests came from Astra (13,620 satellites), Boeing (5,921 satellites), Telesat (1,969 satellites), and Hughes (1,440 satellites).[4] To make things even worse, in October 2021 Rwanda, a State that has no space industry to speak of and just one small satellite in orbit[5], announced that it had requested frequency rights for a LEO constellation of a staggering 327,000 satellites.[6]

Certainly, there are many areas on Earth where internet is rare or not available at all, even in highly developed States such as the United States. The provision of affordable and stable internet coverage for remote areas by multiple satellites by commercial companies could be considered as compliant with Article I of the 1967 Outer Space Treaty, which was adopted

1 They have been defined as "a series of shells or 'elements' each with a fixed height and inclination and a given number of orbital planes and number of satellites per plane.", Jonathan McDowell, https://planet4589.org/astro/starsim/con.html.

2 *Ibid*.

3 Nibedita Mohanta, "How many satellites are orbiting the Earth in 2021?", *Geospatial World,* May 28, 2021, https://www.geospatialworld.net/blogs/how-many-satellites-are-orbiting-the-earth-in-2021/.

4 Michael Sheetz, "In race to provide internet from space, companies ask FCC for about 38,000 new broadband satellites", *CNBC*, November 5, 2021, https://www.cnbc.com/2021/11/05/space-companies-ask-fcc-to-approve-38000-broadband-satellites.html.

5 See the Online Index of Objects Launched into Outer Space, UN Office for Outer Space Affairs, http://unoosa.org/oosa/osoindex/search-ng.jspx.

6 Rwanda Space Agency (@SpaceRwanda), "Rwanda Space Agency Files Request with ITU for Cinnamon-217 and Cinnamon-937 Satellite Constellations", Twitter, 20 October 2021, https://twitter.com/SpaceRwanda/status/1450762768601264137. Apparently, this move is being masterminded by Greg Wyler, a serial entrepreneur and who was also involved Google, O3b and OneWeb, see Chris Forrester, "Wyler behind Rwanda's 300,000 satellite plan", *Advanced Television*, November 8, 2021, https://advanced-television.com/2021/11/08/wyler-behind-rwandas-300000-satellite-plan/. This claim is reminiscent of an ITU filing for several coveted geostationary satellite slots by the tiny Pacific island Tonga in 1988, see "TongaSat", https://en.wikipedia.org/wiki/TONGASAT.

by the United Nations Committee on the Peaceful Use of Outer Space (UN COPUOS) and ratified by the vast majority of States. It provides, in part:

> 'The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out *for the benefit and in the interests of all countries*, irrespective of their degree of economic or scientific development, and shall be the 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. […]' (*emphasis added*).[7]

But is the availability of broadband internet worth the deterioration or loss of astronomical observations? Do we really need that many satellites? How can we manage the unbridled ambitions of "NewSpace" entrepreneurs? The Outer Space Treaty provides some guidance on how to handle private commercial space activity. Article VI places international responsibility for national space activities with the State, and that includes private commercial space activities. States are obliged to authorize and continuously supervise such activities, and they often do that through national space legislation. The last-mentioned treaty also addresses the issue of harmful interference with the activities of other States, in Article IX. It provides that States must have due regard for the activities of other States, and that in case of harmful interference, international consultation should take place to address the issue.

There is also an indication that the Outer Space Treaty recognizes the importance of science, in that same Article I:

> 'There shall be *freedom of scientific investigation* in outer space, including the moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation' (emphasis added).[8]

Science is indeed hugely important to society, and we must realize that without astronomy there would be no space commerce.[9] Astronomy has brought immense knowledge to humankind. Moreover, observatories are often built and operated by public funding at national and international level, and they must be protected. Astronomy has been used traditionally for navigating at sea and in the air. Astronomy also forms an important part

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7 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 January 27, 1967, 610 UNTS 8843. This will be further discussed below. See the full text and status of ratifications of the Treaty at https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties.html. See generally on space law, Tanja Masson-Zwaan and Mahulena Hofmann, *Introduction to Space Law* (Kluwer, 2019).

8 *Ibid*.

9 See on this subject, James Schwartz, *The Value of Science in Space Exploration* (Oxford University Press, 2020).

of the cultural heritage of indigenous people; Aboriginal astronomy for instance goes back tens of thousands of years. Surely all of these are at least as important as broadband internet? So, the million-dollar question is: can a way be found to accommodate both science and commerce in a fair and equitable manner, for the benefit of humankind?

The answer is two-fold. On the one hand, States, and in particular the USA where most operators are based, should try harder to strike a balance among the interests of different stakeholders through the process of authorization and supervision, and States whose astronomical activities are harmed should use the options given to them by the Outer Space Treaty and request consultations. On the other hand, UN COPUOS, as the primary international body for space diplomacy, should play its role by providing a forum for the exchange of views among States as well as all other stakeholders, in order to raise awareness and reach solutions.

2 Technical Reactions from the Industry

Companies such as SpaceX and Oneweb have already engaged in discussions with the astronomical community and have taken technical measures to reduce the reflection of sunlight caused by their satellites. This shows that they are willing to seek solutions, although such voluntary action by some is not a sustainable solution in the longer term, and there is no way to make satellites completely invisible to astronomical observations.

SpaceX has launched several experiments, such as *Darksat*, where a Starlink satellite was covered in black paint in an effort to reduce reflectivity, with some positive results.[10] *Visorsat*, where a sun visor was added to the satellites to block sunlight from the white parts of the main body and the antennas, was more successful and resulted in a noticeable, though still insufficient reduction of light pollution.[11] Similarly, discussions are ongoing with other commercial operators, such as OneWeb. There are also plans to build more space-based telescopes, which could solve part of the problem.[12]

10 Alexandra Witze, "SpaceX Tests Black Satellite to Reduce 'Megaconstellation' Threat to Astronomy", *Scientific American*, January 10, 2020, https://www.scientificamerican.com/article/spacex-tests-black-satellite-to-reduce-ldquo-megaconstellation-rdquo-threat-to-astronomy/, and Jeff Foust, "SpaceX claims some success in darkening Starlink satellites", *SpaceNews*, March 18, 2020, https://spacenews.com/spacex-claims-some-success-in-darkening-starlink-satellites/.

11 Emily Zhang, "SpaceX's Dark Satellites Are Still Too Bright for Astronomers", *Scientific American*, September 10, 2020, https://www.scientificamerican.com/article/spacexs-dark-satellites-are-still-too-bright-for-astronomers/. Also, Anthony Mallama, "Starlink Satellites are Fainter Now - But Still Visible, *Sky & Telescope*, January 22, 2021, https://skyandtelescope.org/astronomy-news/starlink-satellites-fainter-but-still-visible/.

12 Dale Skran, "Space-based astronomy is our future", *Space.com*, March 14, 2020, https://www.space.com/space-based-astronomy-is-our-future-op-ed.html. And also Eric Ralph, "SpaceX CEO Elon Musk talks Starship space telescopes, artificial gravity", *Teslerati*, July 7, 2021, https://www.teslarati.com/spacex-starship-telescopes-artificial-gravity/.

But space-based astronomy also has certain drawbacks, as space telescopes cannot easily be maintained or repaired[13], and there are financial and technical limits on the mass and size that can be sent to space. Moreover, amateur astronomers will most likely not have access to such space-based observing platforms.

3 Astronomers' Initial Reactions and Why They Did Not Work

The initial focus of some astronomers has been on trying to protect the dark skies as a human right. A "Starlight Initiative" and "Starlight Declaration" were issued in 2007, claiming that "an unpolluted night sky should be considered an inalienable right of humankind", and promoting a "World Declaration on the Right to the Starlight as a common heritage of mankind".[14] However, there is no human rights instrument under current international law that recognizes or codifies a human right to unimpeded observation of the night skies.[15]

It has also been suggested that astronomers should bring a claim before the International Court of Justice (ICJ).[16] But the ICJ only settles disputes between States which have recognized its jurisdiction; it cannot be seized by individuals or non-governmental organizations such as astronomical associations.[17] Moreover, the USA has not recognized the jurisdiction of the Court, so a claim against the USA, from where the majority of constellations are being operated, is in any case not an option.

Yet another suggestion was to register the night skies as world heritage under the UNESCO World Heritage Convention.[18] Again, this will not work, because UNESCO can only receive proposals from Member States to protect sites falling under their national jurisdiction and the night skies fall

13 The famous Hubble Space Telescope was repaired in space several times. See NASA, https://www.nasa.gov/mission_pages/hubble/servicing/index.html.

14 See https://starlight2007.net.

15 See for instance the Universal Declaration of Human Rights, https://www.un.org/en/about-us/universal-declaration-of-human-rights, or the International Covenant on Civil and Political Rights, https://www.ohchr.org/en/professionalinterest/pages/ccpr.aspx.

16 Stefano Gallozzi et al., "Concerns about ground based astronomical observations: A step to Safeguard the Astronomical Sky", February 4, 2020 (preprint only), https://arxiv.org/abs/2001.10952v2. The paper contains many legal inaccuracies.

17 The ICJ is the highest judicial organ of the UN, see https://www.icj-cij.org/en. See Jonathan O'Callaghan, "Legal action could be used to stop Starlink affecting telescope images", *New Scientist*, February 3, 2020, https://www.newscientist.com/article/2232324-legal-action-could-be-used-to-stop-starlink-affecting-telescope-images/.

18 UN Convention concerning the Protection of the World Cultural and Natural Heritage, 1972. Its mission is to encourage the identification, protection, and preservation of cultural and natural heritage around the world considered to be of outstanding value to humanity. Member States may identify sites on their territory that deserve protection. See https://en.unesco.org.

under no State's jurisdiction; outer space is free for exploration and use by all States, as provided by Article I of the Outer Space Treaty.

This does not mean that UNESCO has not been active in the field of astronomy. It launched the "Astronomy and World Heritage Initiative" (AWHI) in 2004 with the mission to identify and preserve astronomical sites globally.[19] And in 2008, it created the "Portal to the Heritage of Astronomy" in cooperation with the International Astronomical Union (IAU), with which it concluded a Memorandum of Understanding.[20]

But UNESCO has been clear in rejecting the possibility of protecting the dark skies:

> 'Taking into account the growing number of requests to UNESCO concerning the recognition of the value of the dark night sky and celestial objects, the World Heritage Centre made its first statement in 2007 underlining that the sky or the dark night sky or celestial objects or starlight as such cannot be nominated to the World Heritage List within the framework of the Convention concerning the Protection of the World Cultural and Natural Heritage.
>
> The World Heritage Centre wishes to underline that the "Starlight" Initiative developed by a group of international experts is not part of the UNESCO Thematic Initiative "Astronomy and World Heritage".
>
> […] neither Starlight Reserves, nor Dark Sky Parks can be recognized by the World Heritage Committee as specific types or categories of World Heritage cultural and natural properties since no criteria exist for considering them under the World Heritage Convention.'[21]

In 2020, an international petition titled "Safeguarding the Astronomical Sky" was launched and has been signed by more than two thousand astronomers.[22] They request governments, institutions, and agencies around the world to, amongst others, provide legal protection to ground-based astronomical facilities, put on hold further launches of large constellations, and impose a moratorium on all technologies that can negatively impact astronomical space- and ground-based observations or scientific, technological and economic investments in astrophysical projects. They further seek a right of veto for national and international astronomical agencies on all projects that can negatively interfere with astronomical facilities. Again, these wishes are not realistic, and have no legal validity.

Thus, however appealing all these ideas may seem, none of them is legally tenable. Are there other, better options?

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19 UNESCO, "Astronomy and World Heritage Thematic Initiative", http://whc.unesco.org/en/astronomy/.

20 UNESCO, "UNESCO and the IAU sign key agreement on Astronomy and World Heritage Initiative", https://www.astronomy2009.org/news/pressreleases/detail/iya0803/.

21 See *supra* n. 19.

22 "Appeal by Astronomers: Safeguarding the Astronomical Sky", January 20, 2020, https://astronomersappeal.wordpress.com/.

4 More Realistic Action by the Astronomical Community

Since 2020, various national and international astronomical associations and organizations have brought the issue of interference by satellites to light. Most commercial actors developing large satellite constellations are based in, and operate from, the USA, so it is not surprising that the American Astronomical Society (AAS) was the first to ring the alarm bells, by organizing SatCon1 in June-July 2020[23], followed by SatCon2 in 2021.[24] The report contains some valuable recommendations, for instance that coordinated international regulation of the satellite constellation industry is needed, including oversight and enforcement. It also raises the idea of industry slowing down until meaningful solutions can be developed. Further, it calls on governments to conduct due diligence concerning the activities of commercial satellite operators, specifically regarding the impact of in-orbit operation of such activities.

In Europe, the European Astronomical Society (EAS) has organized sessions on the impact of large constellations on astronomy at its annual conference in June-July 2020[25], and again in 2021.[26] The EAS established a Working Group on satellite constellations focusing on the concerns of astronomers and space scientists in Europe.

At the global level, the IAU, which has 13,000 individual members, issued a statement on satellite constellations in 2019, stating: "we urge appropriate agencies to devise a regulatory framework to mitigate or eliminate the detrimental impacts on scientific exploration as soon as practical". It issued a further statement in 2020, stating: "the IAU considers the consequences of satellite constellations worrisome […]; will continue to initiate discussions with space agencies and private companies".[27] During a presentation at COPUOS in 2020, a representative of the IAU noted that "currently there are no internationally agreed rules or guidelines on the brightness of orbiting manmade objects" and asked to include the subject on the agenda. He also spoke the following true words: "Space users should be continuously reminded that their satellites would not fly nor properly communi-

23 American Astronomical Society, "Satellite Constellations 1 Workshop", https://aas.org/satellite-constellations-1-workshop.

24 American Astronomical Society, "Satellite Constellations 2 Workshop", https://aas.org/satellite-constellations-2-workshop, and executive summary at https://noirlab.edu/public/products/techdocs/techdoc031/.

25 European Astronomical Society, Annual Meeting 2020, https://eas.unige.ch/EAS2020/.

26 European Astronomical Society, Annual Meeting 2021, https://eas.unige.ch/EAS2021/.

27 IAU, "Statement on satellite constellations", June, 13 2019, https://www.iau.org/news/announcements/detail/ann19035/ and IAU, "Understanding the Impact of Satellite Constellations on Astronomy", February 12, 2020, https://www.iau.org/news/pressreleases/detail/iau2001/, respectively.

cate without the essential contributions that astronomy and physics have made to celestial mechanics, orbital dynamics and relativity".[28]

In October 2020, the IAU organized a conference in cooperation with the UN Office for Outer Space Affairs (UNOOSA), named 'Dark and Quiet Skies' (DQS)[29], followed by a second edition in October 2021.[30] In April 2021, the IAU submitted a Conference Room Paper (CRP) to the Scientific and Technical Subcommittee of COPUOS with the support of several COPUOS Member States, summarizing its recommendations.[31] They covered several areas, but were possibly too wide-ranging for the Subcommittee to reach consensus on the proposal for a new agenda item titled "General exchange of views regarding satellite system effects upon terrestrial-based astronomy".

However, discussions on this topic continue in 2022, as "The Subcommittee encouraged the Office for Outer Space Affairs to engage with all relevant stakeholders, such as IAU and others, on the matter of dark and quiet skies as it related to the mandate of the Committee and its Subcommittees, and to present the outcomes of that engagement, including findings for furthering the discussion on the matter, to the Subcommittee for consideration at its fifty-ninth session, in 2022".[32]

5 What Should the US Government Do (and What if it Doesn't)?

As explained, Article VI of the Outer Space Treaty provides for international responsibility of States for the activities of their national entities, which must be implemented at the national level through a process of authorization and continuing supervision, usually by means of national space

28 Piero Benvenuti, "The impact of mega-constellations of communication satellites on Astronomy", presentation at UNCOPUOS Scientific and Technical Subcommittee, February 7, 2020, https://www.unoosa.org/documents/pdf/copuos/stsc/2020/tech-35E.pdf.

29 UNOOSA, "Dark and Quiet Skies for Science and Society", October 2020, https://www.unoosa.org/oosa/en/ourwork/psa/schedule/2020/2020_dark_skies.html.

30 UNOOSA, "Dark and Quiet Skies for Science and Society", October 2021, https://www.unoosa.org/oosa/en/ourwork/psa/schedule/2021/2021_dark_skies.html.

31 "Recommendations to Keep Dark and Quiet Skies for Science and Society", Paper submitted by Chile, Ethiopia, Jordan, Slovakia, Spain and the International Astronomical Union, UN Doc A/AC.105/C.1/2021/CRP.17, April 19, 2021, https://www.unoosa.org/oosa/oosadoc/data/documents/2021/aac.105c.12021crp/aac.105c.12021crp.17_0.html. The areas covered included: 1) The Impact of Satellite Constellations on the Science of Astronomy, 2) Protection of Dark Sky Oases, 3) Protection of Ground-Based Optical Astronomy Sites and Related Science, 4) Protection of the Bio-Environment, and 5) Protection of Radio Astronomy Sites and Related Science. Several COPUOS delegations who were sympathetic to most of the content could not subscribe to the entire set of recommendations because some elements did not fall within the mandate of COPUOS.

32 Report of the Scientific and Technical Subcommittee on its fifty-eighth session, held in Vienna from 19 to 30 April 2021, UN Doc A/AC.105/1240, May 26, 2021, para. 233, https://www.unoosa.org/oosa/en/ourwork/copuos/2021/index.html.

legislation and a licensing process. Currently, most constellation projects operate from the US and the Federal Communications Commission (FCC) is the federal agency in charge of licensing. It could be argued that the FCC should carry out more thorough assessments on the environmental impact of the full project before granting authorization for large constellations.

A problem is that in terms of environmental impact, the FCC is exempted from applying the National Environmental Policy Act (NEPA). This exemption is currently being challenged in a court procedure regarding the authorization by the FCC of the Starlink constellation without applying NEPA.[33]

Whatever the outcome, it can be debated whether applicability of NEPA would make a big difference, since the impact of constellations on science is not purely of an environmental nature. The UN Guidelines on the Long-Term Sustainability of Space Activities, adopted by COPUOS in 2019[34] might be more helpful; States are expected to implement these guidelines in their national legal regime. The US government should fulfil its obligation under Article VI of the Outer Space Treaty in a meaningful manner, and that includes due consideration and protection of the interests of all stakeholders, including the astronomical community, and the need to preserve the long-term sustainability of the space environment.

If another State feels that the US does not adequately fulfil its duty of oversight and this harms its activities, it may be possible to take international legal action. Article IX provides for a mechanism of international consultations in case of harmful interference, allowing States which suffer from harmful interference with their activities to request international consultation. There is no public record of such notifications and none are known to this author, but Article IX could be used increasingly in the future as States feel their interests and investments in science are damaged. In addition, the effect of "naming and shaming" in international fora such as UN COPUOS should not be underestimated.

6 What Should COPUOS Members and Permanent Observers Do?

As mentioned in section 5.1, COPUOS can play a role by providing an international forum for raising international awareness of the need to ensure

33 Jonathan O'Callaghan, "The FCC's Approval of SpaceX's Starlink Mega Constellation May Have Been Unlawful", *Scientific American*, January 16, 2020, https://www.scientificamerican.com/article/the-fccs-approval-of-spacexs-starlink-mega-constellation-may-have-been-unlawful/, and Mike Wall, "Change to SpaceX's Starlink internet constellation faces legal challenge". *Space.com*, June 3, 2021, https://www.space.com/spacex-starlink-megaconstellation-fcc-viasat-dish. Also, Michael Ellis, "Keep Environmental Red Tape out of Outer Space", *The Heritage Foundation*, August 6, 2021, https://www.heritage.org/government-regulation/report/keep-environmental-red-tape-out-outer-space.

34 UNOOSA, "Long-term Sustainability of Outer Space Activities", https://www.unoosa.org/oosa/en/ourwork/topics/long-term-sustainability-of-outer-space-activities.html.

the protection of space science, without which space commerce would not exist. Relevant agenda items in the COPUOS Legal Subcommittee are the "General exchange of views on the application of international law to small-satellite activities", as well as the "General exchange of views on the legal aspects of space traffic management". In the COPUOS Scientific and Technical Subcommittee the agenda item on the "Long-term sustainability of outer space activities" is highly relevant, and discussions will continue in 2022 with input by the IAU and support from COPUOS Member States. As a Permanent Observer at COPUOS, the IAU can make interventions and give presentations to raise awareness and convince States of the need to find a balance among the interests of all stakeholders, rather than only focusing on commercial interests. In addition to the IAU, which represents individual astronomers, there are two international intergovernmental organizations in the field of astronomy which can potentially have more impact. The "European Organisation for Astronomical Research in the Southern Hemisphere" (ESO) is already a Permanent Observer, whereas a new international organization named "SKA Observatory" (SKAO), created in March 2021, has been admitted that same year as a Permanent Observer.[35] They can help to amplify the voice of the astronomical community in COPUOS.

7 Concluding Remarks

Should commerce prevail over publicly funded science? Should we allow the desires of commerce to override the needs of science? Is it fair, equitable, or ethical to let commerce dictate how outer space is used? No, clearly not.

'Free enterprise' must not be allowed to prevail over publicly funded science. The problem is that science does not have as strong a voice as commercial 'pioneers' do, and the astronomical community needs help in clearly formulating its message and broadcasting it to the correct channels. It needs to underline that without space science there would be no space commerce, but it also needs to explain exactly what the issues are and how it would like to see them solved. Commercial enterprise is vital to take space exploration to a next level; after all, private industry made rockets reusable, and the prospect of using resources of celestial bodies would be much less realistic without commercial enterprise investing and pioneering. However, commerce needs to be regulated, so that the 'benefit' and 'equity' principles of the Outer Space Treaty are respected. The ongoing privatization and commercialization of space activities places a much bigger responsibility on States in implementing Article VI than ever before.

35 ESO: https://www.eso.org/; SKAO: https://www.skatelescope.org/news/skao-is-born/ and https://www.skaobservatory.org/. See also SKAO Observatory (@SKAO), "Great news! Yesterday the SKAO was granted Permanent Observership status at the 64th session of UN's Committee on the Peaceful Uses of Outer Space [...]", Twitter, September 3, 2021, https://twitter.com/skao/status/1433749617519255565.

In addition to action at the national level, awareness must also be raised at the international level, and UN COPUOS as the prime forum for international space diplomacy and law-making, must take center stage in that respect.

There is still hope for establishing a balance that is reasonable to the ambitions of commerce and the needs of science, but action is needed now to protect the dark skies as well as global connectivity for the benefit of all humankind.

B:

The Legal Framework for Space Activities: Future Opportunities

VII The Lunar Legal Landscape: Challenges and Opportunities*

This article provides an overview of the current legal landscape for lunar missions and summarizes various initiatives and developments at both the national and international level that complement the existing regulatory framework in this field. The authors tie all these elements together in an effort to give an outlook on the prospects for a sustainable lunar legal landscape in a realistic format and timeline.

1 Introduction

Multiple missions to the Moon and cislunar space are currently in progress or are planned for the coming years by a number of States and regional space agencies, including the European Space Agency, China, India, Russia, South Korea, and the United States (together with the, so far, eight signatories of the Artemis Accords).[1] In addition, a number of private actors are planning lunar missions either independently or in public-private partnerships, including Astrobotic, Intuitive Machines, iSpace (with Draper Lab), and SpaceX. The purposes of these missions range from orbital remote sensing and orbital tourism to resource prospecting and extraction and even the establishment of a permanent human presence on the Moon. Many of the surface missions will be concentrated around the south pole of the Moon where water ice is relatively plentiful.

With so many missions headed to the Moon, often operating in the same area, the time has come to refine the laws that will govern these lunar missions. However, before the international community can properly evaluate the need for legal reform, it is essential to first understand the state of existing law, both domestic and international. This article helps set the stage for such reform by describing the current lunar legal landscape as well as legal developments and initiatives since around 2015. This landscape is evolving as these new initiatives take root and new initiatives are undertaken to ensure that the exploration, utilization, and settlement of the Moon moves forward in the spirit of international cooperation, mutual assistance, and peace.

How the community of space actors, and the international community at large, can move forward in refining and adding to the rules governing

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* *Air and Space Law* 46, no. 1 (2021), pp. 29-56 (with Mark Sundahl).

1 *See* Section 2.3.3. below for a list of Artemis Program partners.

this expanding human activity on the Moon is complicated. The 'holy grail' of legal reform would be the conclusion of a multilateral treaty drafted under the auspices of the United Nations. Even if this does come to fruition one day, it would likely take a decade to develop a comprehensive binding instrument. The pace of technological development and political goals of settling the Moon is outstripping legal innovation, giving some urgency to current initiatives.

In the following section, this article will sketch out the existing fabric of international and domestic space law that is of particular importance to lunar missions. Section III describes a number of current initiatives, both domestic and international, that are addressing legal lacunae and setting the stage for further multilateral efforts to develop lunar law. Finally, the article closes with a summary of the current state of lunar law and observations about opportunities for the next generation of space law.

2 Existing Components of the Lunar Legal Landscape

In this section, an overview is given of international law (hard law and soft law) and national legislation that contain elements relevant for lunar governance. The section focuses on the *lex lata* at the time of writing.

2.1 UN Treaties

Several of the United Nations treaties on outer space make reference to the Moon and other celestial bodies, the most relevant ones being the 1967 Outer Space Treaty[2] and the 1979 Moon Agreement.[3] A brief summary of their relevant provisions follows.

2.1.1 The Outer Space Treaty

The Outer Space Treaty, known as the 'Magna Carta' of outer space is the foundational legal instrument governing the activities of States in outer space. The Moon is explicitly mentioned in every article of the Outer Space

2 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (referred to as Outer Space Treaty or OST), opened for signature on 27 Jan. 1967, entered into force on 10 Oct. 1967, UNTS, vol. 610, No. 8843. The OST currently has 110 States Parties, *see* https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/status/index.html (accessed 24 Nov. 2020).

3 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (referred to as Moon Agreement or MA), opened for signature on 18 December 1979, entered into force on 11 July 1984, UNTS vol. 1363, No. 23002. Even though the Treaty was adopted by consensus in UNCOPUOS, the MA currently has 18 States Parties, not including any of the space powers, *see* https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/status/index.html (accessed 24 Nov. 2020).

Treaty, except Article VIII, which does however mention it implicitly by the words 'on a celestial body', and articles XIV-XVII which deal with procedural matters. Article I provides that the exploration and use of the Moon must 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. States Parties are free to explore and use outer space, as long as the activities are in line with the provisions of the Treaty. This means for instance that activities on the Moon must be in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international cooperation and understanding (Article III). It also means that the Moon must be used 'exclusively for peaceful purposes' (Article IV). Lunar activities by private entities must be authorized and supervised by the 'appropriate State' (Article VI), launching States are internationally liable for damage caused on the Moon by their objects to another State Party, and States have jurisdiction and control over their registered space objects and personnel thereof (Article VIII).

Article II forbids the 'appropriation' of (parts of) the Moon, but does not explicitly specify whether extracting and commercialising lunar resources is in line with its provisions.[4] One of the tasks of a future lunar governance system will be to clarify this matter. A consensus seems to have emerged that resources are not covered by the non-appropriation principle.[5]

In terms of environmental protection, Article IX of the Outer Space Treaty provides that States must explore the Moon in a manner that avoids its harmful contamination or adverse changes in the environment of the Earth resulting from the introduction of extra-terrestrial matter. States Parties are also obligated to enter into consultations when harmful interference with the peaceful activities of another State Party may result from its activities. This Article is often considered as the main basis for 'soft law' rules on space debris mitigation, which is addressed below, but does not impose a very strong legal obligation on States Parties. Articles X-XIII also mention the Moon but will not be further elaborated on here.

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4 *See IISL Position Paper on Space Mining* (20 Dec. 2015, s. II.1.b), http://www.iislweb.org/html/20151220_news.html (accessed 24 Nov. 2020), and *see also* T. Masson-Zwaan & M. Hofmann, *Introduction to Space Law*, ch. 7, (Kluwer 2019) and T. Masson-Zwaan & N. Palkovitz, *Regulation of space resource rights: Meeting the needs of States and private parties*, 35 QIL, Zoom-in 5-18 (2017).

5 *See* e.g. F. Lyall & P. Larsen, *Space Law: A Treatise* 163-188 (2nd. ed., Routledge 2018); F. Tronchetti, *Legal Aspects of Space Resource Utilization*, in *Handbook of Space Law* 769-813 (F. von der Dunk & F. Tronchetti eds, Elgar 2015); R. Jakhu & S. Freeland, *Article II*, in *Cologne Commentary on Space Law*, Vol. I, 44-63 (S. Hobe, B. Schmidt-Tedd, K.U. Schrogl eds, Heymanns 2009); M. Hofmann & F. Bergamasco, *Mining in Outer Space: Legal Aspects*, Eur. Y. B. Int'l Econ L. 313-336 (2018); for a contrary view, *see* G. Oduntan, *Who owns space? US asteroid-mining act is dangerous and potentially illegal*, The Conversation (25 Nov. 2015). *See also* s. 3.2 below, giving an overview of discussions in UNCOPUOS on this matter.

The Outer Space Treaty is widely accepted by space powers and emerging spacefaring nations from all continents, which gives it considerable weight. Nevertheless, its provisions are, as the Treaty's title says, 'Principles' and thus not intended to provide all encompassing detail.

2.1.2 The Moon Agreement

For obvious reasons, the Moon Agreement makes reference to the Moon in each of its articles, except the procedural provisions in Articles 17-21. The treaty also applies to all other celestial bodies in the solar system other than the Earth, unless and until, for instance, a specific treaty for Mars or asteroids would enter into force. The Moon Agreement reiterates and reinforces many of the principles of the Outer Space Treaty. It reiterates the 'province of mankind' principle in Article 4, but also provides in Article 11 (1) that the Moon and its natural resources are 'the common heritage of mankind' (CHM). This principle finds its expression in particular in Article 11(5), which mandates States Parties 'to establish 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.'[6] Article 11(3) further specifies that 'neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become property of any State, international intergovernmental or non-governmental organization, national organization or non-governmental entity or of any natural person.' Although the States Parties to the Moon Agreement have thus committed to reach an international agreement to govern commercial mining activities, it is unclear whether this means that the obligation also covers preliminary stages, such as exploration and prospecting, and whether no commercial activity can take place before such an agreement is in place. Neither seems likely; indeed, a Joint Statement was issued by the States Parties in 2008, proclaiming that the 'common heritage of mankind' principle as embodied in the treaty does not constitute an obstacle to space mining initiatives.[7]

Regarding environmental issues, Article 7 of the Moon Agreement amplifies Article IX OST by stating, in part:

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6 The proper meaning of the CHM concept must be determined in the context of its use and for the purpose of the future applicable regulatory regime. States Parties must make good faith efforts to negotiate in order to reach an agreement, but the result of such negotiations could be a rejection of the concept or giving it a new scope, as has also happened in the field of the law of the sea. See *Cologne Commentary on Space Law* vol. II, 395 (S. Hobe, B. Schmidt-Tedd & K.U. Schrogl eds, Heymanns 2013).

7 *Joint Statement on the benefits of adherence to the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies of 1979 by States Parties to that Agreement*, UN Doc. A/AC.105/C.2/2008/CRP.11 (2 Apr. 2008).

> 'In exploring and using the Moon, States Parties shall take measures to prevent the disruption of the existing balance of its environment whether by introducing adverse changes in that environment, by its harmful contamination through the introduction of extra-environmental matter or otherwise. States Parties shall also take measures to avoid harmfully affecting the environment of the Earth through the introduction of extra-terrestrial matter or otherwise.'

Unfortunately, the impact of the Moon Agreement is limited as so far it has just eighteen States Parties, which include none of the space powers. It must however not be forgotten that the treaty was adopted by consensus in the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), including all space powers, and no State has ever withdrawn. To underline the consensus that has emerged about the legality of space resource utilization, reference can be made to the preamble of the treaty, which specifically mentions the benefits which may be derived from the exploitation of the natural resources of the Moon and other celestial bodies. However, much remains to be done to agree on the details of a multilateral framework to govern such activities.

2.2 Soft Law

Besides the above treaties, there are also 'soft law' instruments that directly or indirectly address the Moon. Although these instruments are not legally binding, their legal effect should not be underestimated, as they may evolve into customary international law with sufficient State practice and *opinio juris*, and thus become binding on States.[8]

Moreover, national space legislation often includes an obligation for private entities to comply with such instruments, making them binding under national law. To encourage this, UN General Assembly resolution 68/75 of 11 December 2013, containing recommendations to States on national legislation relevant to the peaceful exploration and use of outer space,[9] explicitly mentions several of these soft law instruments. A few that are relevant for the topic of this paper are addressed below.

2.2.1 The Declaration of Legal Principles

The 1963 'Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space' (Declaration of Legal Principles), adopted in 1963[10] forms the basis of the Outer Space Treaty of 1967. The principles were later transposed into a treaty in order to have legally binding force. The wording of the Declaration of Principles and the Outer

8 *See* Statute of the International Court of Justice, Art. 38.

9 UN Res. 68/74, Recommendations on national legislation relevant to the peaceful exploration and use of outer space, UN Doc. A/RES/68/74 (11 Dec. 2013).

10 UN Res. 1962 (XVIII) (13 Dec. 1963).

Space Treaty are nearly identical, and although a UN resolution is of itself not legally binding, its consensus adoption by all UN Member States further reinforces the universal validity of the principles.

2.2.2 The Space Benefits Declaration

The 1996 'Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interests of All States, taking into Particular Account the Needs of Developing Countries'[11] (Space Benefits Declaration) is based on Article I of the Outer Space Treaty, which makes it relevant for lunar missions, even though it does not make specific reference to the Moon. Besides reflecting the concerns of the developing countries and stressing the need to take their interests into special account in para. 1, it further provides that 'States are free to determine all aspects of their participation in international cooperation in the exploration and use of outer space on an equitable and mutually acceptable basis' (para. 2), and that 'contractual terms in such cooperative ventures' should be 'fair and reasonable' and in 'full compliance with the legitimate rights and interests of the parties concerned'. Intellectual property rights are explicitly mentioned in this context. This resolution is of particular relevance in the context of the need to ensure equitable sharing of the benefits of lunar exploration and space resource utilization.

2.2.3 The COSPAR Planetary Protection Policy

The relevance of planetary protection in the context of lunar governance is growing as plans for lunar missions increase among both public and private actors. The Committee on Space Research (COSPAR) was established in 1958 by the International Council of Scientific Unions (ICSU) to provide scientific advice on matters concerning scientific space research to the UN and other organizations.[12] The COSPAR Bureau can set up Panels to study topics of interdisciplinary interest. Several of these deal with environmental aspects of space activities, such as the Panel on Potentially Environmentally Detrimental Activities in Space (PEDAS), the Panel on Exploration (PEX) and the Panel on Planetary Protection (PPP). The latter formulated the COSPAR Planetary Protection Policy, which was updated in 2020.[13] It constitutes an international standard on procedures to avoid contamination in space exploration, and serves as a guide for compliance with the Outer Space Treaty, specifically its Article IX. It addresses both backward and

11 UN Res. 51/122 (13 Dec. 1996).

12 ICSU is now named the International Science Council (ISC). Find further information about COSPAR at https://cosparhq.cnes.fr.

13 *See*, https://cosparhq.cnes.fr/scientific-structure/panels/panel-on-planetary-protection-ppp/ (accessed 24 Nov. 2020).

forward contamination and distinguishes five categories of space missions, based on the type of mission (e.g. flyby, orbiter, lander, or sample returns), and the interest of the target body for understanding the origins and evolution of life.

The Moon as a target body falls under Category II, meaning that it is 'a body of significant interest relative to chemical evolution but with only a remote chance that contamination could jeopardize future exploration'. Accordingly, the requirement for a lunar flyby, orbiter or lander mission is to submit certain documentation. If the lunar mission involves a return of samples to Earth, the mission will fall under Category V-Unrestricted, i.e., 'sampling from locations not of biological concern', in which case again, documentation is the only requirement.[14]

Space agencies traditionally follow the Planetary Protection Policy for their missions, and usually have planetary protection offices, which also adopt their own additional policies. For instance, in 2020 NASA announced two 'Interim Directives' on planetary protection, one of which concerns the Moon.[15] Missions to the Moon's polar regions and to the Apollo landing sites will remain in Category II, whereas all other lunar missions will become Category I ('not of direct interest for understanding the process of chemical evolution or the origin of life') instead of Category II, meaning there are no requirements. Indeed, growing scientific insight requires a continuous evolution of planetary protection principles, and the increased interest in the Moon and the growing number and diversity of actors indicate a need for lunar governance to include planetary protection principles, and to ensure adherence by private actors.

2.2.4 The UN Space Debris Mitigation Guidelines

Prior to the adoption of the UN guidelines on debris mitigation, space agencies from around the world had been collaborating in this field. The Inter-Agency Debris Coordination Committee (IADC) adopted debris mitigation guidelines in 2002.[16] These served as the basis for the discussions in UNCOPUOS, leading in 2007 to the UN General Assembly endorsement of the Space Debris Mitigation Guidelines previously adopted by UNCOPUOS.[17]

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14 Masson-Zwaan & Hofmann, *supra* n. 4, ch. 9. *See also Protecting the Environment of Celestial Bodies: The Need for Policy and Guidelines* (M. Hofmann, P. Rettberg, M. Williamson eds, IAA 2010).

15 *See* J. Foust, *NASA implements changes to planetary protection policies for Moon and Mars missions*, Space News (July 2020), https://spacenews.com/nasa-implements-changes-to-planetary-protection-policies-for-moon-and-mars-missions/ (accessed 24 Nov. 2020).

16 IADC Space Debris Mitigation Guidelines, rev. 1, IADC-02-01, https://www.iadc-online.org/ (accessed 24 Nov. 2020) at 'documents' (Sept. 2007).

17 UN Res. 62/217, International cooperation in the peaceful uses of outer space, UN Doc. A/RES/62/217 (22 Dec. 2007).

The UN guidelines use the same definition of space debris as the IADC guidelines: 'space debris is defined as all man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional'. This seems to exclude debris on celestial bodies such as the Moon, and in fact the Moon is not even mentioned in the guidelines, although some of the seven guidelines could also be conceived as applying to celestial bodies, notably guidelines 1 (limit debris released during normal operations); 2 (minimize the potential for break-ups during operational phases); and 4 (avoid intentional destruction and other harmful activities). It may however be advisable to clarify this, and to address the particular characteristics of debris located on a celestial body, as opposed to in orbit. In contrast to orbital debris, waste will not eventually re-enter the earth's atmosphere, and so the usual debris disposal methods will have to be reassessed.[18]

2.2.5 The UN Guidelines for the Long-Term Sustainability of Space Activities

After nearly ten years of debate marked by political tensions, UNCOPUOS adopted twenty-one guidelines on the Long-term Sustainability of Space Activities (LTSSA) in 2019.[19] The long-term sustainability of outer space activities is defined as:

> 'the ability to maintain the conduct of space activities indefinitely into the future in a manner that realizes the objectives of equitable access to the benefits of the exploration and use of outer space for peaceful purposes, in order to meet the needs of the present generations while preserving the outer space environment for future generations'.[20]

The twenty-one non-legally binding, voluntary guidelines address the policy, regulatory, operational, safety, scientific, technical, international cooperation, and capacity-building aspects of space activities and are divided in four groups:

- Policy and regulatory framework for space activities (five guidelines);
- Safety of space operations (ten guidelines);

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18 *See* in this context A. Salmeri *e.a.*, *Waste Management for Lunar Resources Activities: Towards a Circular Lunar Economy*, 71st International Astronautical Congress, IAC-20-D4.5.16 (2020).

19 Report of the Committee on the Peaceful Uses of Outer Space, UN Doc. A/74/20, para 163 and Annex II (3 July 2019). For an overview of the work of UNCOPUOS on the Long-Term Sustainability of Space Activities, *see* http://www.unoosa.org/oosa/en/ourwork/topics/long-term-sustainability-of-outer-space-activities.html (accessed 24 Nov. 2020). Consensus could not be reached on seven remaining guidelines, they can be found in UN Doc. A/AC.105/2018/CRP.21 (27 June 2018).

20 Report of the Committee on the Peaceful Uses of Outer Space, UN Doc. A/74/20, Annex II.I.5 (3 July 2019).

– International cooperation, capacity-building, and awareness (four guidelines);
– Scientific and technical research and development (two guidelines).

The guidelines do not explicitly mention the Moon, but will of course indirectly have an impact on lunar governance. The guidelines must be seen as a living document which will be periodically reviewed, revised or added to, so that they may continue to ensure the long-term sustainability of outer space activities.[21] States are now called upon to take measures to ensure that the guidelines are implemented to the greatest extent feasible and practicable, and various States have started reporting to the Subcommittee about their actions in that context. In 2019, a new working group on the topic was established under the Scientific and Technical Subcommittee of UNCOPUOS, where these discussions will be continued.[22] It would be advisable to take the guidelines into account when developing a lunar governance system.

2.3 Domestic Laws

Beneath the umbrella of international law, many States have enacted domestic legislation to implement their international obligations as well as to regulate (as well as nurture) their domestic space industry. When a private space industry emerges in a State, Article VI of the Outer Space Treaty requires that the State authorize and continually supervise this private activity, as explained above in Section 2.A.1. Even before a domestic industry emerges, some States enact legislation in order to foster the growth of private activity by providing regulatory clarity. Generally speaking, domestic legislation is primarily dedicated to the creation of a process for licensing the launch of space vehicles and the subsequent carrying out of certain traditional space activities, such as communications, broadcasting, remote sensing, and navigation.[23] These domestic laws typically do not address lunar activities. The exception to this rule is found in those States that have legislated with respect to resource extraction, an activity that will necessarily take place upon the establishment of a permanent human presence on the Moon.

21 *See* P. Martinez, *UN COPUOS Guidelines for the Long-Term Sustainability of Outer Space Activities: Early Implementation Experiences and Next Steps in COPUOS*, 71st International Astronautical Congress, IAC-20-E.3.4.1 (2020).
22 *See* UN Doc. A/74/20, para. 165.
23 *See* Mark J. Sundahl, *Regulating Non-Traditional Space Activities in the United States in the Wake of the Commercial Space Launch Competitiveness Act*, 42(1) Air & Space L. 29 (2017).

2.3.1 United States

The United States was the first State to enact legislation specifically addressing space resource activities. The centerpiece of Title IV of the 2015 *US Commercial Space Launch Competitiveness Act* (CSLCA) is the addition of Section 51303 to the US Code. This new section allowed for those engaged in space resource activity to assert ownership rights over extracted resources[24]:

> '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.'

Although this legislation was a bold and unprecedented step forward for the future of space resource activity, the law fell short of its promise in certain respects. First of all, the law only recognizes the right of a 'United States citizen' to own space resources, which narrows the reach of the law and leaves uncertainty as to the rights of foreign entities who may come before a US court or administrative agency claiming a right to space resources.[25] Another shortcoming of the law is that it provides no clear process or mechanism for resolving one of the primary concerns of space mining pioneers: how will companies be protected from other operators (both domestic or foreign) who interfere with their planned or ongoing mining activity (*i.e.* 'claim jumping')? An earlier version of the draft law created a new civil action precisely for the resolution of conflicting claims.[26] Moreover, that version of the law instructed the judge presiding over such an action to issue judgment in favor of the party that was 'first in time to conduct the activity' – provided that the activity was 'reasonable for the exploration and utilization of [space] resources.' In effect, this would have created a 'first in time' system of establishing priority rights to space resources. That said, the wording of this draft bill presented its own problems, including the difficulty of determining at what point a company's activity would lock in the company's priority rights. Would the remote identification of future mining sites qualify as an activity that was 'reason-

24 51 USC §51303.

25 The phrase 'citizen of the United States' is defined as including, in addition to an individual with US citizenship, any company organized in the United States or a company organized in another State that is controlled by a US company or citizen. *Ibid*. §50902.

26 Space Resource Exploration and Utilization Act of 2015, H.R. 1508, 114th Congress (2015) available at www.congress.gov/bill/114th-congress/house-bill/1508/text (accessed 24 Nov. 2020).

able for the exploration and utilization of [space] resources', thus giving the company priority rights to the identified site?[27]

Although Congress ultimately decided not to create a new cause of action to protect mining claims, Title IV does instruct the President, through federal licensing agencies, to[28]:

promote 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.

In short, rather than creating a civil court action, Congress left it to federal agencies to ensure non-interference through its existing licensing processes. One way in which this could be done is by making all licenses conditional on the licensee not interfering with existing space resource activity. But would the licensing agency also prohibit the licensee from mining sites that have not yet been touched, but have been publicly identified as a future mining site by another company? How would the agency decide which future sites should be given such protection? Without further regulatory guidance, the agency would have to make an *ad hoc* determination which mining claims deserved protection and which did not. But this leads to an even more fundamental question: Which agency will make these determinations and enforce these conditions? Congress has not yet given any agency in the US government authority to license space resource activity or, for that matter, any other private activity on the Moon.[29] The likely candidates for receiving such authority are the Federal Aviation Administration Office of Commercial Space Transportation (FAA-AST), which currently issues launch and reentry licenses in addition to licensing spaceports, and the Office of Space Commerce in the Department of Commerce, which currently licenses remote sensing activity, enforces export controls, and oversees space traffic management.

2.3.2 *Luxembourg*

Two years after Title IV of the CSLCA took force in the United States, the *Law of July 20th 2017 on the Exploration and Use of Space Resources* was enacted by Luxembourg in order to provide regulatory clarity to the nascent space

27 It has also been argued that the US missed an opportunity to create a broader solution to the problem of potential disputes over space resources by failing to provide for the mutual recognition of mining authorizations granted to commercial entities by foreign states as had been done for deep seabed mining. *See* Thomas E. Simmons, *The Unfortunate Provincialism of the Space Resources Act*, The Space Review (25 Jan. 2016) at www.thespacereview.com/article/2910/1 (accessed 24 Nov. 2020).

28 51 USC §51302. What type and how much activity would have been needed to trigger this protection was unclear.

29 *See* Sundahl, *supra* n. 23.

mining industry.[30] As a result, the Grand Duchy has become a hub of space resource activity.[31]

Like the US law, the core of the Luxembourg legislation is the recognition that '[s]pace resources are capable of being owned.'[32] (Note that in contrast to the US law, this ability to own space resources is not limited to citizens.) Beyond the recognition of ownership, the Luxembourg law states that 'no person can explore or use space resources without holding a written mission authorization from the minister or ministers in charge of the economy and space activities.'[33] In order to apply for an authorization, the applicant must either incorporate in Luxembourg or have a registered office in Luxembourg. This does not prevent foreign companies from seeking the protections of Luxembourg law – the entity need only form a subsidiary or open a registered office in Luxembourg.

The remainder of the law sets out the requirements and procedures for acquiring authorization. An authorization will only be granted if, and is made conditional on, the applicant showing (i) financial means, (ii) robust internal governance and auditing systems, (iii) the requisite skill, knowledge, and experience, and (iv) the 'good repute' of its shareholders.[34] Once an authorization is issued, the law requires that it be worked.[35] The authorization will be withdrawn if the operator 'does not make use' of the authorization within 36 months of issuance. Likewise, the authorization will be withdrawn if work ceases for 6 months or more at any time.

Unlike the US law, there is no mention in the Luxembourg law of the need to avoid harmful interference with the activity of other operators. However, the law does provide for the operator's liability for damage caused by its activities: 'The operator that is granted an authorisation for a mission is fully responsible for any damage caused at the occasion of the mission, including at the occasion of all preparatory works and duties.'

30 Law of July 20$_{th}$ 2017 on the Exploration and Use of Space Resources ('Luxembourg Law'). Although the English version of the law will be quoted in this article, it should be noted that the French version is authoritative. The English text, https://space-agency.public.lu/en/agency/legal-framework/law_space_resources_english_translation.html. The French version, http://legilux.public.lu/eli/etat/leg/loi/2017/07/20/a674/jo (accessed 24 Nov. 2020).

31 Luxembourg had previously enacted the Law of 1991 on Electronic Media which established that a license is required to operate a satellite telecommunications system in Luxembourg. At the time of writing, a general space law is in the final stages of the parliamentary process in Luxembourg which will establish 'general rules on compliance with international law and environmental protection, including space debris.' In addition to establishing a domestic registry for space objects, the new law will also 'set up a system of authorization, monitoring and sanctions.' See https://space-agency.public.lu/en/agency/legal-framework.html (accessed 24 Nov. 2020).

32 Luxembourg Law art. 1.

33 *Ibid.* Art. 2(1).

34 *Ibid.* Arts. 7-11.

35 *Ibid.* Art. 14.

In addition to imposing potential liability on authorized actors, the law imposes steep penalties (e.g. EUR 1 million per day), and even prison time, for conducting space resource activity without authorization or in contravention of the conditions of an authorization.

As under the US law, the question arises how Luxembourg will protect the interests of companies engaged in space resource activities, in particular, the interest of a company in mining a site that it has previously identified through remote sensing. It would be easy enough for Luxembourg to require as a condition of its authorizations that the authorized party not interfere with another entity's ongoing operations on the Moon. But does the law protect future mining sites from being poached by another company?

An answer to this question may lie in a provision of the Luxembourg law that mentions 'preparatory works' of mining companies, which would presumably include the remote prospecting for, and selection of, potential mining sites. By bringing 'preparatory works' into the scope of the law with respect to an operator's harmful actions, it is not a large jump to say that the party whose 'preparatory work' is damaged through harmful interference with a site selected by another mining concern could have an action for liability. In other words, could an operator who has plans to mine a particular site on the Moon, and made these plans public, sue for damages if another party authorized by Luxembourg harms the planned operation by poaching the site and mining it itself?

Unfortunately, it is still unclear what the nature and breadth of the authorization conditions will be and how the courts will react to such a theory of liability. To end on a high note, however, Luxembourg does have the advantage over the US regulatory system in that the Luxembourg law makes a clear grant of authority to authorize space resource activity to the 'minister or ministers in charge of the economy and space activities.'

2.3.3 Two Other Examples of Domestic Legislation: Japan and the UAE

So far, two other States, Japan and the United Arab Emirates (UAE), have made changes to their law or administrative processes in order to accommodate and encourage space resource activity. In Japan, the change was minimal and merely consisted of a small change to a licensing application, rather than to the law itself. Specifically, in the application form for a license to operate a satellite (Form 17), the question regarding 'the purposes and methods of using the spacecraft' has been changed so that applicants now select from a number of choices, one of which is 'Space Science and Exploration, including space resources exploration.' This amendment makes clear that space resources exploration is a lawful activity under Japanese law. However, Japanese law continues to be silent on issues relating to protections against harmful interference with space resource activity or priority rights to mining sites. That said, as is the case in the US and Luxembourg, the Japanese authorities could include a prohibition against harmful

interference with the activity of others in the conditions of a license. The Japanese case highlights the fact that merely because a State's domestic laws do not expressly permit for space resource activity does not necessarily mean that such activity is prohibited. The change in the application format, although subtle, is a clear indication that space resource activity is permissible under Japanese law.

The UAE has taken a more formal approach in its *Federal Law No. (12) of 2019 on the Regulation of the Space Sector*, an omnibus national space law that contains an Article 18 on 'Exploration, Exploitation and Use of Space Resources.'

Like the Luxembourg law, Article 18 grants clear authority to the Council of Ministers to regulate space resource activity. More specifically, the law gives the Council the authority to issue permits 'for the exploration, exploitation and use of Space Resources, including their acquisition, purchase, sale, trade, transportation, storage and any Space Activities aimed at providing logistical services in this regard.'[36] The legal effect of this article is perhaps greater than it first appears. Although the article appears to merely be a grant of authority to regulate, it contains within it two critical presuppositions: first, that the extraction of space resources is permissible under the UAE's interpretation of international law and, second, that extracted resources can be privately owned.

3 Current Initiatives and Discussions

In this section, several initiatives addressing the *lex ferenda* for lunar governance will be highlighted, and an overview of discussions in UNCOPUOS will be given.

3.1 The Hague Building Blocks for the Development of an International Framework on Space Resource Activities

The multi-stakeholder 'The Hague International Space Resources Governance Working Group' was created in 2016 as the outcome of a Roundtable on the Governance of Space Resources, convened by The Hague Institute for Global Justice in December 2014. The Working Group concluded its work at the end of 2019 with the adoption of twenty 'Building Blocks for the Development of an International Framework on Space Resources

36 UAE Federal Law No. (12) of 2019 on the Regulation of the Space Sector available at https://u.ae/en/about-the-uae/science-and-technology/key-sectors-in-science-and-technology/space-science-and-technology (accessed 24 Nov. 2020).

Governance'.[37] The Building Blocks aim to lay the groundwork for potential future negotiations on a framework to govern space resource activities.

A Commentary to the Building Blocks was published in 2020 to provide background about the formulation of the Building Blocks and to analyze the legal basis and discussion behind each provision.[38] The Working Group included members and observers from space agencies, industry, academia, science, international organizations and civil society. The group felt that a future international framework should create an enabling environment for space resource activities that takes into account all interests and benefits all countries and humankind.

The Building Blocks are based on the concept of 'adaptive governance', meaning that they do not try to address all aspects from the start, but should evolve on the basis of growing insight and understanding. A prime example of the application of this concept is that the Building Blocks only address the use of resources in outer space, and not their eventual return to earth.

The Building Blocks include technical, legal, scientific, industrial, business and social perspectives, thus reflecting the multifaceted character of space resource utilization. They include definitions of key terms, provisions regarding access to and rights over space resources, safety measures related to space resource activities, prevention and mitigation of their potentially harmful impact, sharing of benefits from space resource activities, and a number of general provisions. The Building Blocks also include provisions regarding the attribution of priority rights to operators to search and/or recover space resources *in situ* for a maximum period of time within a maximum area upon registration in an international registry as well as the

37 The Working Group was hosted by the International Institute of Air and Space Law at Leiden University. Funding for the functioning of the group and for administrative support was provided by the Dutch government with contributions by Secure World Foundation and Deep Space Industries, later joined by the University of Luxembourg, Nishimura & Asahi, and ispace. See for more information about the Working Group, such as links to the Final Reports, the text of the Building Blocks, meeting reports, lists of members and observers and more: https://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-of-air-space-law/the-hague-space-resources-governance-working-group (accessed 24 Nov. 2020). Five papers with annual updates were published between 2017 and 2020, *see* T. Masson-Zwaan et al., *The Hague Space Resources Governance Working Group: A Progress Report*, Proc. Int'l Inst. Space L. 2016, 163 (Eleven 2017); T. Masson-Zwaan et al., *The Hague Space Resources Governance Working Group: Second Progress Report*, Proc. Int'l Inst. Space L. 2017, 281 (Eleven 2018); T. Masson-Zwaan et al., *The Hague Space Resources Governance Working Group: Third Progress Report*, Proc. Int'l Inst. Space L. 2018, 761 (Eleven 2019); T. Masson-Zwaan et al., *The Hague international space Resources Governance Working group: Final Progress report*, 70th International Astronautical Congress, IAC-19-D4.5.1 (2019); T. Masson-Zwaan et al., *The Hague International Space Resources Governance Working Group: Conclusion and Way Forward*, 71st International Astronautical Congress, IAC-20-D4.5.1 (2020).

38 See https://www.boomdenhaag.nl/en/webshop/building-blocks-for-the-development-of-an-international-framework-for-the-governance-of-space-resource-activities (accessed 24 Nov. 2020).

establishment of safety zones to assure safety and to avoid any harmful interference with space resources activity.

The impact of the Building Blocks is still emerging, and as can be seen in the following sub-sections they have already influenced subsequent initiatives that further develop their content.

3.2 UNCOPUOS

In 2016, shortly after the adoption of the first national law on space resources utilization by the US, the Legal Subcommittee of UNCOPUOS adopted an agenda item titled 'General Exchange of views on potential legal models for activities in exploration, exploitation and utilization of space resources. This item was addressed in 2017, 2018 and 2019, but in 2020 the session of the Legal Subcommittee was cancelled due to the COVID-19 pandemic. This section provides a summary of the discussions at these sessions.

In 2017,[39] the discussions did not go into much detail. Belgium submitted a Conference Room Paper that was quite critical about commercial space resources utilization. It asked, for instance:

> 'what would be the purpose of prohibiting national appropriation of celestial bodies while allowing the same nations to exclusively determine the use of their resources, surely the most valuable and, hence contentious, part of celestial bodies? What would be the point of reserving celestial bodies' use to a universal purpose while letting some nations with the highest technological development take all the benefit of their resources?'[40]

It was suggested that a broad debate should take place within the Legal Subcommittee as the appropriate forum, involving especially developing countries. The need for a multilateral approach and the need for national legislation to conform to the principles enshrined in the UN space treaties were mentioned in this context. There were States who felt that national laws in this field could lead to the development of multiple incompatible national frameworks, which would pose a risk of conflicts among States and potentially impact the sustainability of outer space. Some States argued that the regulation of private sector actors in outer space is consistent with a State's international obligations under the Outer Space Treaty, that the extraction of resources from the Moon or a celestial body is a 'use' within the meaning of and permitted by article I of the Outer Space Treaty, and

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39 Report of the Committee on the Peaceful Uses of Outer Space, UN Doc. A/72/20 (27 June 2017). See also Report of the Legal Subcommittee, UN Doc. A/AC.105/1122, paras. 221-250. Some of the early reactions at UNCOPUOS were summarized by O. Bittencourt Neto & Th. Cheney at the *Symposium on Legal Aspects of Space Resource Utilization* held in Leiden on 17 Apr. 2016, *see* https://www.universiteitleiden.nl/en/events/2016/04/symposium-on-legal-aspects-of-space-resource-utilisation (accessed 24 Nov. 2020).

40 UN Doc. A/AC.105/C.2/2017/CRP.19.

that the principle of non-appropriation only applies to natural resources 'in place'. Accordingly, once such resources are removed, ownership rights can be exercised by States or private entities. But other States felt that exploitation of space resources is not covered by the concept of freedom of exploration and use, and that recognition by States of ownership rights over resources that were not at their national disposal would be in conflict with the non-appropriation principle in article II of the Treaty.

In 2018,[41] two Conference Room Papers about The Hague Space Resources Governance Working Group were submitted, one by Belgium (as a follow-up to its 2017 paper) and one by the Netherlands.[42] In its paper, Belgium criticized the work of the Hague Working Group, by arguing:

> 'In the absence of any actual mandate received from States and of a formal mechanism ensuring their representation, Belgium does not acknowledge such initiatives as providing a 'forum for negotiations on an international framework'. We regret that the work of some experts, though potentially valuable, has been undertaken in a manner that, eventually, creates confusion and generates interference with the work of UNCOPUOS.'

Belgium suggested that 'fundamental enquiries' should be carried out and presented a list of five questions to that effect. In a reaction to this criticism, it was stated that:

> 'the discussions on space resources in the Hague Space Resource Governance Working Group had been conducted in an open, inclusive and transparent manner, with the intention of producing a document containing building blocks that could contribute to the regulation of space resources for the consideration of States and the international community.'[43]

Some delegations suggested that all stakeholders, including both government and private actors, should closely cooperate, so that future activities would be developed in a proper and practical manner as well as in accordance with international law, and that it would be appropriate for such discussions to take place in the Legal Subcommittee. As in 2017, concerns were expressed about unilateral approaches, which were considered likely to raise uncertainty over the validity and application of international law; these States considered that a regulatory regime for the exploitation of space resources should be developed within COPUOS and must be agreed to by the international community as a whole, taking into account the interests of all States. A proposal was made to create a working group with the mandate

41 Report of the Committee on the Peaceful Uses of Outer Space, UN Doc. A/73/20 (5 July 2018). See also Report of the Legal Subcommittee, UN Doc. A/AC.105/1177, paras. 229–265.

42 *See* UN Doc. A/AC.105/C.2/2018/CRP.8 and UN Doc. A/AC.105/C.2/2018/CRP.18, respectively.

43 UN Doc. A/AC.105/1177, para. 234.

to develop and propose to the Legal Subcommittee alternative legal solutions capable of providing the legal certainty necessary for acts of exploration, exploitation and utilization of outer space resources, but the proposal was not adopted.

In 2019,[44] most delegations were of the view that an international legal framework is needed within which space resources activities could be undertaken, hence the discussion no longer centered so much on the legality of using resources, but focused on its modalities and governance. Principles of sustainable use, avoidance of harmful contamination, and efficiency were brought up as possible elements of such a framework, and the need for appropriate international safety standards as well as for international coordination to avoid competing interests and conflicts. Some States considered that national legislation which safeguard international obligations in general terms only was not sufficient to ensure compliance with the spirit of the Outer Space Treaty, and that a situation of 'first come, first served' would create a *de facto* monopoly and would thus be in contradiction with the letter and spirit of the Outer Space Treaty. Others argued that commercial space resources activities are consistent with the UN treaties and that the Outer Space Treaty does not preclude such activities. The delegation of the Netherlands informed the Subcommittee about the work of the Hague International Space Resources Governance Working Group, and several delegations mentioned that this work was of great importance and that consideration of the Building Blocks for the governance of space resource activities would greatly enhance discussions in the Subcommittee.

The establishment of a working group was again proposed, this time by Greece and Belgium.[45] While some delegations supported the proposal, others were of the view that the Subcommittee should not move too quickly, as regulation might stifle innovation. There was discussion about the timeframe of the working group and its mandate. It was suggested that it should be open-ended and its scope should be comprehensive in terms of substance, and that possibly an assessment should be carried out of the scientific, technological, economic and financial capacities of the international community in the field of research, development and use of space resources prior to developing any legal framework. It was also suggested that the work of the Scientific and Technical Subcommittee and the Legal Subcommittee should be closely coordinated.

Although there was no agreement on the establishment of a working group, the Committee decided to hold 'scheduled informal consultations' and endorsed the nomination by Belgium and Greece of two co-moderators

44 Report of the Committee on the Peaceful Uses of Outer Space, UN Doc. A/74/20 (3 July 2019). See also Report of the Legal Subcommittee, UN Doc. (A/AC.105/1203, paras. 239–267).

45 UN Doc. A/AC.105/C.2/L.311, Working paper by Belgium and Greece containing a proposal for the establishment of a working group on the development of an international regime for the utilization and exploitation of space resources.

to lead these consultations during the fifty-ninth session of the Legal Subcommittee in 2020. It was further agreed that the co-moderators 'would present to States members of the Committee, in the intersessional period, a draft plan for the scheduled informal consultations containing proposed substantive topics for discussion and their rationale. States would be invited to provide comments accordingly.' The Secretariat would send out that draft plan, and responses from States would be sent to the co-moderators for their consideration.[46] The aim of these consultations will be 'to have a broad and inclusive exchange of views on the future deliberations concerning the exploration, exploitation and utilization of space resources, including the possible establishment of a working group under the relevant agenda item, taking into account possible future coordination with the Scientific and Technical Subcommittee, as appropriate.'[47]

The draft plan for the scheduled informal consultations, which are intended to be 'inclusive, impartial, comprehensive and transparent', was circulated to the COPUOS Member States, and the deadline for replies was set at 31 January 2020.[48] The draft plan contains procedural and proposed substantive topics for discussion. In terms of *process*, the co-moderators suggest to clarify the mandate for the discussions, summarize the inputs received, and establish the modalities for the conduct of the discussions. In terms of *substance*, the proposals cover the principles contained in the Outer Space Treaty and their interpretation, as well as other relevant international space law regimes and treaty arrangements, relevant 'soft law' guidelines and relevant principles of general international law. Furthermore, it is suggested to address the role of domestic legislation and the relevance of work by experts, other entities, universities, space agencies and industry stakeholders as well as input from other groups such as The Hague Working Group. The ultimate aim is 'to identify the major fields of possible agreement and major issues regarding which delegations continue to fundamentally disagree' and to 'arrive at legal certainty and predictability for all public and private actors […] and to ensure the consistency thereof with applicable international law'.

As stated above, the 2020 session of the Legal Subcommittee was cancelled due to COVID-19, and the scheduled informal consultations are now expected to take place in 2021.

3.3 NASA's Artemis Accords

The Artemis Accords form the legal foundation for NASA's Artemis program, an international partnership of space agencies dedicated to

46 UN Doc. A/AC.105/1203, para. 278.
47 *Ibid*., para. 279.
48 Copy on file with the authors.

returning humans to the Moon by 2024.[49] Although the mission to the Moon is the primary objective at this point in time, the Accords are intended to govern a broad array of missions on 'Mars, comets, and asteroids, including their surfaces and sub-surfaces, 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.'[50] The Accords ensure that, whatever the specific nature of NASA's cooperation with a particular space agency, all Artemis-related activity will comply with the fundamental principles of international law and certain best practices. The more detailed terms of NASA's cooperation with particular space agencies will be captured in separate bilateral agreements, all of which will incorporate the terms of the Accords by reference.[51]

The obligations under the Accords will then flow down to any agencies or other parties acting on behalf of the contracting States (including, presumably, any private companies that are contracted to assist in the program).[52] The current signatories that signed the document on 13 October 2020 are Australia, Canada, Italy, Japan, Luxembourg, the United Arab Emirates, and the United Kingdom. Other States are invited to accede to the Accords simply by 'submit[ting] its signature to the Government of the United States.'[53] This was done by Ukraine on 15 November 2020.[54]

According to Section 1 of the Accords, their underlying purpose is 'to increase the safety of operations, reduce uncertainty, and promote the sustainable and beneficial use of space for all humankind.'[55] The approach taken by the Accords to achieve these goals begins with the reiteration of certain core principles under existing international law, including (i) the obligation to use space exclusively for peaceful purposes, (ii) the obligation to rescue astronauts and recover space objects, (iii) the duty to act with due regard to the interests of others, and (iv) the duty to seek consultation with the affected State if there is a possibility of harmful interference with that State's activities.[56] In fact, the international spirit of the Accords is undeniable. In addition to much of its content being drawn from existing treaties, the Accords strongly encourage multilateralism. In Section 10, for example, the Accords require its signatories to participate in the multilateral development of international law 'including through ongoing efforts at the COPUOS.'[57]

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49 The text of the Artemis Accords can be found at https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf (accessed 24 Nov. 2020).

50 Artemis Accords s. 1.

51 *Ibid*. s. 2.1.

52 *Ibid*. s. 2.1(4).

53 *Ibid*. s. 13.3.

54 *See* https://ua.usembassy.gov/ukraine-becomes-the-9th-country-to-sign-the-artemis-accords/ (accessed 24 Nov. 2020).

55 *Ibid*. s. 1.

56 *Ibid*. ss. 2 & 11(1) *et* passim.

57 *Ibid*. s. 10.4.

Beyond merely confirming existing law, the Artemis Accords introduce new ideas for implementing these legal obligations in an operational context.[58] Among the more innovative ideas in the Accords is the concept of 'safety zones' that a State would declare around their operations. The definition of 'safety zones' in Section 11 of the Accords clarifies that these zones are merely for informational purposes to help to avoid interference:[59]

In order to implement their obligations under the Outer Space Treaty, the Signatories intend to provide notification of their activities and commit to coordinating with any relevant actor to avoid harmful interference. The area wherein this notification and coordination will be implemented to avoid harmful interference is referred to as a 'safety zone'.

In other words, giving public notice of the location and nature of lunar activity, along with the parameters of a safety zone, is necessary in order to allow for the full implementation of the obligations under Article IX of the Outer Space Treaty to act with 'due regard' to the interests of other space actors and seek consultation in the event of potential harmful interference.[60] A State can only operate with due regard to the extent that such State is aware of other lunar activities. If no notice of an activity is given, a State cannot expect to be protected by the duty of due regard. In contrast, by providing public notice pursuant to Section 11 of the Artemis Accords, a State is protected by such notice because due regard requires the active avoidance of harmful interference.

How exactly these safety zones would be measured is left open by the Artemis Accords – as it should be. A variety of factors might influence the size of a safety zone. For example, the size of a safety zone could be significantly influenced by the nature of the activity. For example, the safety zone for a mining operation using explosives would require a relatively large zone -- in contrast to an operation that merely scrapes ice off the surface of the Moon (which may not need much of a safety zone at all). However, the Accords do provide the following basic principles to help determine the appropriate parameters of a safety zone:[61]

- 'A safety zone should be the area in which nominal operations of a relevant activity or an anomalous event could reasonably cause harmful interference.'
- 'The size and scope of the safety zone . . . should reflect the nature of the operations being conducted and the environment that such operations are conducted in…'
- 'The size and scope of the safety zone should be determined in a reasonable manner leveraging commonly accepted scientific and engineering principles.'

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58 The Accords were drafted, in part, to 'provide for *operational implementation* of important obligations contained in the Outer Space Treaty and other instruments.' *Ibid.* s. 1 (emphasis added).

59 *Ibid*. s. 11.7.

60 *Ibid*. s. 7.

61 *Ibid*.

To encourage transparency in the methods and rationales for creating safety zones, every signatory to the Accords has the right to request the basis for the creation of a safety zone.[62] Finally, the Accords promote taking a multilateral approach in the future 'to further develop international practices, criteria, and rules applicable to the definition and determination of safety zones and harmful interference.'[63]

Safety zones serve two purposes. First, they protect other space actors by giving notice when there is a risk of harmful interference. If another actor conducts activities within the safety zone, a court may conclude that this was done at its own risk. On the other hand, one could argue that liability is more likely to be imposed if actors outside the safety zone suffer harm.

Under the *Convention on International Liability for Damage Caused by Space Objects*, a State is liable for any damage caused in space by its own space object to another space object (or any persons or property onboard) 'if the damage is due to its fault or the fault of persons for whom it is responsible.' What constitutes 'fault' under a particular set of circumstances may be difficult to determine in light of the infancy of lunar activity and the lack of generally recognized standards of behavior. However, the establishment of safety zones may assist in determining fault. The argument would be that if a State is operating within the safety zone established by another State and causes damage to the latter State's operations, the offending State could be found 'at fault' for irresponsibly operating within the safety zone.

Some commentators are concerned that the Unites States intend to treat safety zones as their exclusive property in contravention of the Outer Space Treaty.[64] Such claims are in fact contradicted by the language of Section 11(10) where it is made clear that while notification and coordination is required, there is no prohibition against operating within a safety zone, but only a duty to give notice and coordinate:[65]

The Signatories commit to respect reasonable safety zones to avoid harmful interference with operations under these Accords, including by providing prior notification to and coordinating with each other before conducting operations in a safety zone established pursuant to these Accords.

Again in Section 11(11), the principle of universal free access is emphasized without restriction: 'The Signatories commit to respect the principle of free access to all areas of celestial bodies and all other provisions of the Outer Space Treaty in their use of safety zones.' [66]

62 *Ibid*. s. 11.8.
63 *Ibid*. s. 11.6.
64 *See* e.g. A. Boley & M. Byers, *U.S. Policy Puts the Safe Development of Space at Risk*, Science 174 (9 Oct. 2020).
65 *Ibid*. s. 11.10.
66 *Ibid*. s. 11.11.

The Artemis Accords are a product of our times. NASA is supportive of UN initiatives to explore the possibility of new law governing lunar activity, but the UN process will likely take a decade or more to produce an agreement of any significance. In the meantime, NASA must move forward while the political will of Congress supports the Artemis program and should be respected for building a team of international partners who, through the Artemis Accords, promise to observe existing space law as a condition of joining the venture.

3.4 MVA Best Practices for Sustainable Lunar Activities

Rounding out the picture of the lunar legal landscape is the role of non-governmental entities that are engaged in initiatives to support the evolution of space law to facilitate the peaceful expansion of lunar activity. One such non-governmental organization is the Moon Village Association (MVA), which has engaged in a multilateral effort to develop an initial set of 'Best Practices for Sustainable Lunar Activities'.

The MVA was incorporated in Vienna in 2017 with the goal of implementing the 'Moon Village' concept by serving as a hub of communication for stakeholders in the new international push to establish a permanent human presence on the Moon.[67] The concept of the Moon Village is a vision of peaceful global cooperation in lunar exploration and utilization. The concept contemplates a collection of international efforts that involve both governmental and non-governmental entities conducting activities in a spirit of cooperation and mutual assistance. In this vision, everyone is welcome to contribute to humanity's future on the Moon in accordance with their individual capabilities.[68]

The overarching goal of the Best Practices is to develop a set of voluntary standards of behavior and principles that will ensure the long-term sustainability of lunar activities. Turning to their substance, the Best Practices include core principles for responsible lunar activity as well as provisions that encourage the creation of standards of behavior to address the practical challenges of establishing a permanent human presence on the Moon. The Best Practices were drafted by the members of the MVA's Coordination & Cooperation Committee and draw on existing legal instruments and initiatives, including the existing space treaties, the UN Long-Term Sustainability Guidelines, and the Hague International Working Group's Building Blocks for an international framework for space resource activities.

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67 Further information about the Moon Village Association, www.moonvillageassociation.org (accessed 24 Nov. 2020).

68 For the roots of the Moon Village concept *see* Jan Wörner, *Moon Village: A Vision for Global Cooperation and Space 4.0* (2016) at www.esa.int/About_Us/Ministerial_Council_2016/Moon_Village (accessed 24 Nov. 2020).

An earlier version of the Best Practices was opened for public consultation on 5 March 2020 for six months, during which time the MVA hosted a series of webinars to seek additional input on the Best Practices from all stakeholders, including government agencies, industry, academia, and members of the general public. After the close of the consultation period, a preliminary revised version of the Best Practices was the subject of a virtual roundtable discussion with representatives of nine space agencies before a final version was released on 19 October 2020.

The Best Practices take a multi-prong approach to refining the lunar legal landscape by (i) highlighting existing principles of international law that are of particular relevance to lunar missions, (ii) suggesting how best to implement these principles on the lunar surface; and (iii) suggesting certain innovations to supplement existing law.

The more innovative aspects of the Best Practices are found in those sections that suggest new standards for lunar activity, including the following:

- Encouraging the avoidance of harmful interference with existing (or planned) activities;
- Recommending how to satisfy the legal obligation to share benefits;
- Encouraging measures to (i) mitigate the creation of lunar orbital debris and (ii) avoid causing adverse changes to sites of significant scientific or historical interest on the Moon;
- Recommending the enhanced registration of space objects under the Registration Convention to provide information about the location and nature of lunar activity;
- Recommending limiting space resource activity as to location and duration in order to ensure equitable and responsible use of limited resources;
- Encouraging space actors to share information and best practices through an international publicly available database; and
- Suggesting that, in time, a dedicated registry of lunar activities should be established.

The Best Practices are not static, but will continuously evolve in step with the development of lunar activity. The next phase of this project will be entrusted to a new expert group, the Global Expert Group on Sustainable Lunar Activities (GEGSLA), whose membership is to be drawn from thought leaders in government, industry, and academia.

3.5 Vancouver Recommendations and Open Letter on Space Mining

In March 2020, the Outer Space Institute (OSI) at the University of British Columbia in Vancouver, Canada, organized a transdisciplinary roundtable with participants from a wide range of States and backgrounds, including government, industry, and academia. The discussions at this meeting led to

the adoption of the 'Vancouver Recommendations on Space Mining'.[69] They should not be seen as an alternative, rather, they 'are intended to support other recommendations and guidelines, most notably the 'Building Blocks' adopted by The Hague International Space Resources Governance Working Group in November 2019.' The recommendations focus on an international regime for space mining and provide that negotiations to that effect should be open to all States and seek input from science, industry and other non-governmental stakeholders.

The recommendations consist of seven points, the last of which contains twenty-five items that States should consider during such negotiations. These are in some instances similar to what is contained in The Hague Building Blocks, but seem to place a stronger focus on environmental and scientific aspects. For instance, they not only recommend compliance with the COSPAR planetary protection policy, but also the elaboration of further planetary protection standards specific to space mining. They also mention avoidance of potentially hazardous orbital changes to celestial bodies; securing samples in a manner that is compatible for eventual return for scientific research prior to extraction; and minimizing the lifting and transport of lunar dust. In respect of benefit sharing, the Vancouver recommendations go further than The Hague Building Blocks, as they encourage the establishment of a mandatory benefits sharing mechanism, including the sharing of monetary benefits.

The Vancouver Recommendations led to a follow-up initiative in August 2020, when an 'International Open Letter on Space Mining' was sent to the UN Secretary-General, stressing the need for a multilateral agreement on the exploration, exploitation, and utilization of space resources and calling on States to present a resolution at the UN General Assembly that urges UNCOPUOS to negotiate such an agreement. It specifically states:

> 'It is our opinion that the speed and scale of developments relating to the exploration, exploitation and utilization of space resources require more affirmative and urgent action. The undersigned therefore urge States to present for adoption at the United Nations General Assembly, a resolution which would request UNCOPUOS to negotiate, with all deliberate speed, a draft multilateral agreement on space resource exploration, exploitation and utilization for consideration by the General Assembly.'[70]

The letter was signed by numerous persons, including several Nobel laureates and former ministers. Some members of the Hague Working Group also signed, but a number of space lawyers declined, including the authors

69 *See* http://www.outerspaceinstitute.ca/docs/Vancouver_Recommendations_on_Space_Mining.pdf (accessed 24 Nov. 2020).

70 *See* http://www.outerspaceinstitute.ca/docs/InternationalOpenLetterOnSpaceMining.pdf (accessed 24 Nov. 2020).

of this paper.[71] The international impact of this letter remains to be seen, but it has possibly had some influence on the negotiations on the 2020 Artemis Accords, which Canada has signed.

4 Conclusion and the Way Forward

As has become clear from the above, the future lunar legal landscape may well comprise international and national law evolving in parallel, at least for the near future. The Outer Space Treaty provides general principles and does not seem to prohibit commercial use of space resources; the Moon Agreement is more detailed but of limited relevance because of the low number of ratifications. International soft law fills in some of the details, especially in terms of sustainability, planetary protection and debris mitigation, but leaves other issues open. The development of national laws has so far been limited to a few cases, and these laws are more or less consistent and do not contradict international law. Moreover, they are necessary for States where space resources activities are expected to occur, as States Parties to the Outer Space Treaty are under the obligation to authorize and supervise such space activities pursuant to Article VI. It is however not desirable that many more States revert to unilateral lawmaking, as that might lead to a scattered legal landscape.

Without a doubt, the preferred solution is a multilateral regime for lunar activities including space resources activities, and several initiatives have started to formulate elements that may be useful in that regard. The primary forum for agreeing on a multilateral framework is UNCOPUOS. This will be a complex and lengthy process, but as evidenced by the adoption of the long-term sustainability guidelines in 2019, it is not impossible. During the first years of discussions on this topic in the Legal Subcommittee, a shift has already occurred from questioning the very legality of space resources utilization towards a gradual conviction that this activity will be happening and should be regulated internationally.

During the 2021 Legal Subcommittee meetings, the scheduled informal consultations will take place in accordance with the draft plan of the co-moderators and the input from Member States received so far. These consultations will hopefully lead to the establishment of a Working Group with a concrete mandate and timeline, including the task to consider the relevant preparatory work that has taken place these past years. The Building Blocks of the Hague Working Group had already been submitted for the subsequently cancelled 2020 session by the Netherlands and Luxembourg as a formal working paper and are available in all six UN

71 One reason being that the topic is already on the agenda of COPUOS as the prime forum for space law making, and it is preferable to await the results of the 'scheduled informal consultations' and the establishment of a working group, as envisaged.

languages.[72] Likewise, the US is expected to submit the Artemis Accords for the 2021 session, as per Section 10.4.

The MVA Best Practices will also be submitted either as a working paper by one or more delegations or as a Conference Room Paper by the MVA, which has permanent observer status. Any follow up to the Vancouver Recommendations and the UN Open Letter on Space Mining should also be taken into account. Furthermore, as has already emerged during previous sessions, the input of the Scientific and Technical Subcommittee should be sought, as well as, ideally, that of industry. The plethora of prior analysis and possible options should assist Member States in making good progress in a reasonable timeframe.

As the adoption of a new treaty is not likely in the current geopolitical climate, the eventual result of the discussions in UNCOPUOS might take the form of a General Assembly resolution providing guidelines for equitable and sustainable lunar activity by governmental as well as non-governmental actors, accompanied by recommendations to States wishing to adopt national legislation in this field. In the end, reaching international agreement in this promising new area of space activity will benefit all stakeholders.

72 UN doc. A/AC.105/C.2/L.315, 3 Feb. 2020, available at https://www.unoosa.org/oosa/en/ourwork/copuos/lsc/2020/index.html (accessed 24 Nov. 2020).

VIII L'exploitation des Ressources Spatiales et le Droit International*

Depuis quelques années, quelques entreprises privées visent à commercialiser l'extraction et l'utilisation de ressources spatiales telles que l'eau ou le platine présents sur la lune et d'autres objets célestes, comme les astéroïdes[1]. Notamment aux États-Unis, plusieurs acteurs commerciaux développent des plans pour l'exploitation des ressources dans l'espace et ont levé des fonds d'investissement. La croissance rapide et continue des activités commerciales dans l'espace augmentera le besoin d'un approvisionnement de matériaux de survie, de métaux et d'autres produits de base pour soutenir l'expansion durable de l'économie de la Terre dans l'espace. Puisqu'un certain nombre d'entreprises ont présenté de telles stratégies d'exploitation et de commercialisation des ressources de la lune et des astéroïdes, cet article examine les implications juridiques de leurs activités. Sont-elles autorisées, et si oui, à quelles conditions ? Que dit le droit international de l'espace, et quelle est l'importance de la législation nationale dans ce contexte ? Comment assurer le développement équitable et durable de ces nouvelles activités qui offrent une perspective passionnante à l'humanité, tout en protégeant les intérêts de toutes les parties prenantes ?

Afin de réaliser leurs projets, ces entreprises doivent investir considérablement et ont besoin de sécurité juridique. En particulier, elles veulent savoir si elles peuvent obtenir des droits de propriété sur les ressources à extraire, afin de les commercialiser. Or, le droit international de l'espace n'apporte pas de réponse claire à cette question.

Le droit spatial est né peu après le début de l'ère spatiale à la fin des années 1950. L'Organisation des Nations Unies (ONU) a créé le « Comité des utilisations pacifiques de l'espace extra-atmosphérique » (CUPEEA) en 1958[2]. Dans ce cadre, un certain nombre de traités et de résolutions

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* *L'Espace extra-atmosphérique et le droit international*, Clémentine Bories & Lucien Rapp (eds.), (Pédone, 2021), pp. 315-332

1 Les astéroïdes et la lune sont tous deux des « corps célestes » et ont le même statut en droit spatial ; les mêmes règles s'appliquent donc indépendamment de la nature, de la taille, de l'emplacement ou de la composition du corps céleste. Même si les pionniers initiaux (Planetary Resources et Deep Space Industries) n'existent plus, plusieurs autres entreprises investissent et développent des technologies dans ce domaine (par ex. Ispace et Space Mining Corporation).

2 Le CUPEEA, généralement appelé *COPUOS* (d'après l'abréviation anglaise de *Committee on the peaceful uses of outer space*), comprend deux sous-comités, un sous-comité scientifique et technique, et un sous-comité juridique. Un aperçu historique du CUPEEA est disponible sur le site du Bureau des affaires spatiales, le secrétariat du CUPEEA.

ont été conclus qui, ensemble, forment le *corpus juris spatialis*[3]. Le premier traité spatial de l'ONU est le Traité sur l'espace, ouvert à la signature le 27 janvier 1967 et entré en vigueur le 10 octobre de la même année[4]. Cent trente-trois États ont ratifié ou signé cette *Magna Carta* du droit spatial. Certaines parties du traité, qui ne compte que dix-sept articles, peuvent être considérées comme droit international coutumier[5]. Ce premier traité a été suivi de quatre autres, dont le dernier, l'Accord sur la Lune, a été ouvert à la signature le 18 décembre 1979 et est entré en vigueur le 11 juillet 1984[6]. Ce traité compte seulement dix-huit États membres, et les puissances spatiales comme les États-Unis, la Russie ou la Chine n'en font pas partie ; l'importance de cet accord est donc discutable, étant donné que, pour l'instant, ce sont surtout des entreprises américaines qui élaborent des plans d'exploitation de ressources spatiales. C'est regrettable, car l'accord contient des éléments tout à fait utiles.

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3 Pour un aperçu général des questions du droit spatial, v. https://www.unoosa.org/oosa/en/ourwork/spacelaw/index.html. L'ensemble des sites internet cités dans cet article ont été consultés pour la dernière fois le 21 mai 2021. Voir également, F. Lyall & P. Larsen, *Space Law : A Treatise* (2e ed.), London, Routledge, 2018, 548 p. ; T. Masson-Zwaan, M. Hofmann, *Introduction to Space Law*, Alphen aan den Rijn, Kluwer law international, 4th edition, 2019, 248 p. ; et, parmi les classiques : B. Cheng, *Studies in International Space Law*, Oxford, Clarendon Press, 1997, 866 p. Voir également M. Lachs, *The Law of Outer Space : an Experience in Contemporary Law-Making* (réédité à l'occasion du 50e anniversaire de l'Institut international de droit spatial), Leiden, Brill-Nijhoff, 2010, 180 p.

4 Traité sur les principes régissant les activités des États en matière d'exploration et d'utilisation de l'espace extra-atmosphérique, y compris la Lune et les autres objets célestes, 27 janvier 1967, Nations Unies, *Recueil des Traités*, vol. 610, n° I-8843, p. 205. Au 1er janvier 2020, le traité comptait 110 États parties et 23 États l'avaient signé, mais pas encore rat ifié à cette date, voir https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/status/index.html.

5 Sur le droit coutumier de l'espace, voir par exemple R. Jakhu & S. Freeland, « The relationship between the Outer Space Treaty and customary international law », *in* P. J. Blount, T. Masson-Zwaan, R. Moro-Aguilar, K. -U. Schrogl (Eds.), *Proceedings of the International Institute of Space Law*, Leiden, Eleven international publishing, 2016, pp. 183-199; V. Vereshchetin, G. Danilenko, « Custom as a source of international law of outer space », *Journal of Space Law* 1985, tome 13, vol. 1, pp. 22-35. Bin Cheng parle de « droit coutumier instantané » puisqu'il ne s'agit pas d'une pratique étatique de longue date, les voyages dans l'espace n'ayant débuté que dans les années 1960 : B. Cheng, « United Nations resolutions on outer space: 'instant' international customary law », *Studies in International Space Law II,* Oxford, Clarendon Press, 1997, Part II, ch. 7.

6 Accord réglementant les activités des États sur la Lune et les autres corps célestes, 11 juillet 1984, Nations Unies, *Recueil des Traités*, vol. 1363, n° 23002, p. 3. L'Accord avait 18 parties et 4 États l'ont signé au 1er janvier 2020. Les trois autres traités en la matière ne seront pas abordés dans cette communication : l'Accord sur le sauvetage des voyageurs de l'espace, le retour des voyageurs de l'espace et le retour des objets amenés dans l'espace du 22 avril 1968, (Nations Unies, *Recueil des Traités*, vol. 672, n° 9574, p. 119), la Convention sur la responsabilité internationale pour les dommages causés par des objets spatiaux du 29 mars 1972 (Nations Unies, *Recueil des Traités*, vol. 961, n° I-13810), et la Convention sur l'immatriculation des objets introduits dans l'espace du 12 novembre 1974 (Nations Unies, *Recueil des Traités*, vol. 1023, n° 15020, p. 15). Pour une analyse approfondie des traités et résolutions des Nations Unies sur l'espace, voir S. Hobe *et al*. (dir.), *Cologne Commentary on Space Law*, 3 volumes, Köln, Heymann, 2015, 780 p.

Ce sont ces deux traités en particulier qui jouent un rôle dans la question de la légalité de l'exploitation des ressources dans l'espace, et plus précisément la question de savoir si les entités privées peuvent obtenir des droits de propriété sur les ressources qu'elles espèrent trouver sur les corps célestes pour pouvoir les commercialiser[7]. Cette activité se déroulera dans un premier temps principalement dans l'espace lui-même, par exemple, pour soutenir le fonctionnement d'une base lunaire et la vie de ses occupants. On peut également imaginer une « station-service » près de la Lune, pour des missions à destination de Mars. Le retour des ressources sur Terre est loin d'être réalisable d'un point de vue technologique et financier et se fera dans un futur bien plus lointain. En examinant la question de savoir si le droit international de l'espace peut apporter suffisamment de sécurité juridique, il deviendra évident que le Traité de l'espace ne fournit pas une réponse claire, alors que l'Accord sur la Lune prend une position plus claire, mais qui est, en raison du concept controversé de « patrimoine commun de l'humanité », issu du droit maritime international, reconnu par trop peu d'États pour avoir un véritable impact pour le moment[8].

En 2015, les États-Unis ont adopté une loi nationale qui tente de donner aux entreprises américaines la sécurité juridique nécessaire. En 2017, le Luxembourg, où plusieurs de ces sociétés se sont désormais installées, a également pris des mesures similaires, ainsi que les Émirats arabes unis en 2019 et le Japon en 2021[9]. Outre les intérêts des États et des entreprises qui ont déjà les capacités ou les ressources pour l'exploitation des ressources spatiales, il faut également reconnaître ceux des États qui ne disposent pas actuellement de ces capacités ou ressources, mais qui peuvent et veulent y

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7 Parmi les sources sur les aspects juridiques de l'exploitation des ressources spatiales, voir Ph. de Man, *Exclusive Use in an Inclusive Environment: The Meaning of the Non-Appropriation Principle for Space Resource Exploitation*, 1st edition, New York, Springer, 2016, 516 p. ; F. Tronchetti, *The Exploitation of Natural Resources of the Moon and Other Celestial Bodies: A Proposal for a Legal Regime*, Leiden, Brill, 2009, 382 p.; P. Larsen, « Asteroid Legal Regime: Time for a Change ? » *Journal of Space Law*, vol 39, n° 2, 2014, pp. 275-326; T. Masson-Zwaan, N. Palkovitz, « Regulation of Space Resource Rights: Meeting the Needs of States and Private Parties », *Questions of international law*, n° 35, 2017, pp. 5-18. voir aussi IISL/ECSL, « Symposium on Legal Models for Exploration, Exploitation and Utilization of Space Resources, 50 Years after the Adoption of the Outer Space Treaty », 27 March-7 April 2017, https://www.unoosa.org/oosa/en/ourwork/copuos/lsc/2017/symposium.html.

8 Le concept de « patrimoine commun de l'humanité » a été introduit dans le droit maritime par le diplomate maltais A. Pardo pour désigner les ressources des fonds marins. L'interprétation de ce concept a suscité beaucoup de controverses et des États comme les États-Unis n'ont pas ratifié le traité. Le Traité de la Lune a été adopté à une époque où les relations Nord-Sud étaient tendues et où des appels à un nouvel ordre économique international ont surgi. Pour une discussion sur l'histoire de ce concept et sa signification en droit spatial, voir par exemple, S. Hobe, « Common Heritage of Mankind : an Outdated Concept in International Space Law? » *Proceedings of the 40th Colloquium on the Law of Outer Space*, AIAA, 1999, pp. 271-285.

9 Ces lois sont examinées plus en détail dans la section 3.2.

jouer un rôle à l'avenir. Pour être équitable et efficace, le futur cadre juridique de l'exploitation des ressources spatiales devra également servir les intérêts de ces États.

Malheureusement, le droit international de l'espace ne donne pas une image claire de la légitimité de l'exploitation des ressources spatiales. Par conséquent, la question se pose de savoir si la législation nationale peut fournir une solution à la place, ou si un nouveau cadre juridique international à établir serait plus approprié[10]. Les questions suivantes sont abordées plus en détail ci-dessous : que prévoient les traités ? Quel est le rôle de la législation nationale ? Quelles sont les visages que pourrait adopter un cadre juridique internationalement adapté ?

1 L'État du Droit : Le Traité de l'Espace et l'Accord sur la Lune

Cette section est l'occasion de revenir sur l'apport juridique des articles du Traité sur l'espace et de l'Accord sur la Lune qui ont un impact sur l'exploitation commerciale des ressources spatiales.

1.1 Le Traité de l'espace

Quelques dispositions du Traité de l'espace sont importantes pour l'exploitation des ressources spatiales. Pour commencer, l'article premier stipule que l'exploration et l'utilisation de l'espace extra-atmosphérique doivent se faire « pour le bien et dans l'intérêt de tous les pays, quel que soit le stade de leur développement économique ou scientifique ; elles sont l'apanage de l'humanité tout entière ». Il existe donc une liberté d'exploration et d'utilisation de l'espace pour tous les États. Le problème est que ce concept n'est pas défini et peut faire l'objet d'interprétations diverses. Fournit-il simplement une orientation morale aux États, ou doit-il être considéré comme une obligation internationale dont la violation peut constituer un fait internationalement illicite pouvant engager la responsabilité de l'État ?

Il semble assez difficile de constater de façon objective une violation de ce principe. Or, il pourrait être considéré plutôt comme un appel à parvenir à une forme de « partage » et à empêcher une « ruée vers l'or ». Ce partage ne signifie pas nécessairement que tous les profits qui seraient éventuellement réalisés devront être partagés parmi tous les États membres de l'ONU ; d'autres formes de « partage » sont également envisageables,

10 T, Masson-Zwaan & M. Sundahl, « The Lunar Legal Landscape: Challenges and Opportunities », *Air & Space Law* vol. 46, n°1, 2021, pp. 29–56 ; Voir aussi, J. Mariez, « À qui appartiennent Mars, la Lune et leurs ressources naturelles ? », *The Conversation*, 13 juillet 2020.

comme la sous-traitance, la création d'un fonds international de recherche ou encore le partage de certains résultats scientifiques[11].

L'article II contient le principe dit de non-appropriation : « L'espace extra-atmosphérique, y compris la Lune et les autres corps célestes, ne peut faire l'objet d'appropriation nationale par proclamation de souveraineté, ni par voie d'utilisation ou d'occupation, ni par aucun autre moyen ». Cela signifie qu'il ne peut y avoir de souveraineté dans l'espace extra-atmosphérique, contrairement à la Terre ou dans l'espace aérien au-dessus du territoire d'un État. Il est interdit de revendiquer la propriété d'une partie quelconque de l'espace extra-atmosphérique. À l'instar de l'article I, l'article II peut faire l'objet de différentes interprétations, comme récemment constaté dans le contexte des activités liées aux ressources spatiales. Une question importante dans ce contexte est de savoir si la propriété des ressources extraites est autorisée, quoique sous certaines conditions, ou devrait être considérée comme une « appropriation » au titre de l'article II, et donc interdite.

En d'autres termes, s'agit-il uniquement d'une propriété immatérielle ou également d'une propriété matérielle ? Certains soutiennent que l'appropriation de ressources est également interdite, car sinon l'interdiction de l'article II serait une coquille vide[12]. D'autres, dont l'auteur de cet article, estiment que la propriété des ressources n'est pas explicitement interdite et que, par conséquent, on peut supposer qu'elle est permise, quoique sous certaines conditions à définir. Après tout, la réponse contraire annulerait l'intérêt de l'Accord sur la Lune, adopté par consensus au CUPEEA.

Comme l'exploitation commerciale des ressources spatiales sera très vraisemblablement réalisée par des sociétés privées, éventuellement en collaboration avec des États, l'article VI du Traité est également d'une grande importance. Cet article peut être considéré comme une reconnaissance, dès les années 1960, que toutes les activités spatiales ne seraient pas menées uniquement par des États, mais aussi par des organisations internationales et des entités privées. Pour ce dernier groupe, l'article prévoit que leurs activités « doivent faire l'objet d'une autorisation et d'une surveillance continue de la part de l'État approprié partie au Traité ». Cette disposition

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11 La Station spatiale internationale (SSI) en est un bon exemple. Seuls les astronautes des 15 partenaires de l'*ISS* et un nombre limité d'invités d'autres États peuvent vivre et travailler dans l'espace pendant un certain temps, mais les résultats scientifiques, les photos et les expériences sont partagés à l'échelle mondiale et profitent à l'humanité tout entière. Bien sûr, l'exploitation des ressources spatiales a en fin de compte un but lucratif, ce qui rend la question plus complexe.

12 Voir par exemple R. Jakhu, cité dans « U.S. Space-Mining Law Seen Leading to Possible Treaty Violations - 1967 Outer Space Treaty Prohibits any Commercial Exploitation of Space Law, Professor Says », *CBC News*, 26 November 2015 ; voir de même G. Oduntan, « Who Owns Space ? US Asteroid-Mining Act Is Dangerous and Potentially Illegal », *The Conversation*, 25 novembre 2015, https://theconversation.com/who-owns-space-us-asteroid-mining-act-is-dangerous-and-potentially-illegal-51073.

a incité de plus en plus d'États à adopter une législation spatiale nationale, leur permettant de s'acquitter de cette obligation d'autorisation et de surveillance continue[13]. Cela se fait généralement au moyen d'un système de licences, assorti d'une obligation d'assurance et d'un droit de l'État à recouvrer tout dommage auprès de l'entreprise. Les États doivent veiller à ce que les sociétés minières spatiales ne violent pas leurs obligations au titre du Traité et doivent créer un cadre juridique pour que les entreprises se conforment à ces obligations. Elles doivent assurer, par exemple, que les entreprises ne placent pas d'armes nucléaires ou d'autres armes de destruction massive dans l'espace et à ce que les corps célestes ne soient utilisés qu'à des fins pacifiques, comme le prévoit l'article IV. L'article XII peut également être mentionné dans ce contexte ; il énonce que toutes les stations et installations, tout le matériel et tous les véhicules spatiaux se trouvant sur la Lune ou sur d'autres corps célestes doivent être accessibles, dans des conditions de réciprocité, aux représentants des autres États membres du traité. Les États pourraient, par exemple, imposer une condition de licence pour que les entreprises respectent cette règle. L'article stipule également qu'une notification préalable doit être donnée pour chaque visite prévue afin que « le maximum de précautions puissent être prises pour assurer la sécurité et éviter de gêner les opérations normales sur les lieux de l'installation à visiter ».

L'article III prévoit que l'exploration et l'utilisation de l'espace doivent s'effectuer « conformément au droit international, y compris la Charte des Nations Unies, en vue de maintenir la paix et la sécurité internationales et de favoriser la coopération et la compréhension internationales ». En vertu de cet article, la majorité des obligations étatiques mises en place par le droit international public s'appliquent également à l'exploration et l'utilisation de l'espace. Les États doivent donc veiller à ce que les activités des entreprises privées ne violent pas ces obligations. On peut penser par exemple au droit international de l'environnement. Dans ce contexte l'article IX du Traité est également à citer. Il indique que les États doivent explorer la Lune « de manière à éviter les effets préjudiciables de leur contamination ainsi que les modifications nocives du milieu terrestre résultant de l'introduction de substances extraterrestres ». Les États parties sont également tenus d'engager des consultations internationales préalables si leurs activités peuvent causer une gêne potentiellement nuisible aux activités d'autres États parties au traité. Cet article est souvent considéré comme la base des règles « non contraignantes » sur la réduction des débris spatiaux, même s'il n'impose pas une obligation juridique très forte aux États parties.

Bien que le Traité de l'espace n'apporte pas de réponse claire à la question de savoir si l'exploitation commerciale des ressources spatiales est autorisée, et notamment si les ressources sont susceptibles d'appropriation,

13 Pour un aperçu des lois spatiales nationales, voir https://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw.html.

il ne semble pas l'interdire, même si certaines de ses dispositions paraissent imposer un encadrement juridique[14].

1.2 L'Accord sur la Lune

L'accord sur la Lune a été qualifié d' « échec » par certains États, compte tenu du faible nombre d'États parties, au rang desquels aucune des puissances spatiales. Il convient toutefois de noter que le texte de l'Accord a été adopté par consensus au sein du CUPEEA, en présence de ces mêmes puissances spatiales[15]. Ni les États-Unis, ni le Luxembourg, ni le Japon ne sont parties à l'Accord, bien que ce soient les seuls États où des sociétés minières spatiales sont basées à ce jour. Néanmoins, il est utile d'analyser l'Accord de plus près, car c'est le seul des cinq traités spatiaux des Nations Unies qui envisage les activités commerciales. Surtout, cet Accord contient le principe controversé du « patrimoine commun de l'humanité », dont la signification ambiguë a également conduit à la non-ratification des États-Unis de la convention des Nations Unies sur le droit de la mer[16].

Certains principes fondamentaux du Traité de l'espace ont été précisés dans cet instrument, comme le principe de non-appropriation de l'article 11-1. Cet article interdit explicitement les droits de propriété sur les ressources pour les personnes morales et physiques, et déclare également que « la Lune et ses ressources naturelles constituent le patrimoine commun de l'humanité, qui trouve son expression dans les dispositions du présent Accord, en particulier au paragraphe 5 de du présent article ». Ainsi, le principe de non-appropriation de l'Accord sur la Lune va au-delà de l'article II du Traité de l'espace, qui ne parle ni de ressources ni de personnes morales et physiques.

Le paragraphe 5 de l'article 11 oblige les États à établir un régime international régissant l'exploitation des ressources naturelles de la Lune lorsque cette exploitation deviendra possible, ce qui semble désormais être le cas, y compris par des procédures appropriées. On peut rappeler l'exemple de l'Autorité internationale des fonds marins, qui a eu un succès assez limité[17].

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14 Voir *Position Paper on Space Resource Mining*, Institut International de Droit Spatial, 20 Decembre 2015, point II. 2 : https://iislweb.space/wp-content/uploads/2020/01/SpaceResourceMining.pdf.

15 Les parties à l'Accord ont publié une déclaration conjointe en 2008 appelant les États à le ratifier et mettant l'accent sur ses aspects positifs : Committee on the Peaceful Uses of Outer Space Legal Subcommittee, *Joint Statement on the benefits of adherence to the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies of 1979 by States Parties to that Agreement*, A/AC.105/C.2/2008/CRP.11, 2 April 2008, https://www.unoosa.org/pdf/limited/c2/AC105_C2_2008_CRP11E.pdf.

16 Convention des Nations unies sur le droit de la mer, signée le 10 décembre 1982 à Montego Bay, Nations Unies, *Recueil des Traités*, vol. 1834, n° 31363, p. 3.

17 Voir Accord relatif à l'application de la partie XI de la Convention des Nations Unies sur le droit de la mer, 10 décembre 1982, conclu à New York le 28 juillet 1994, Nations Unies, *Recueil des Traités*, vol. 1836, n° 31364, p. 3.

Il conviendrait de se tourner vers d'autres solutions. Les dix-huit parties à l'Accord sur la Lune pourraient, dès à présent, procéder à l'instauration d'un tel régime, mais jusqu'ici, aucune mesure n'a encore été prise pour le faire[18]. Il est également douteux qu'un tel régime ait du sens sans que les États, dans lesquels les sociétés concernées sont établies, soient liés par celui-ci.

Le paragraphe 7 indique les principaux objectifs du régime international à établir, car celles-ci pourraient être utiles même pour établir un type différent de réglementation pour l'exploitation des ressources spatiales, au cas où l'Accord demeurerait inefficace à cause du manque d'adhésion par les États actifs dans ce domaine. Ces objectifs sont :

- D'assurer la mise en valeur méthodique et sans danger des ressources naturelles de la Lune ;
- D'assurer la gestion rationnelle de ces ressources ;
- De développer les possibilités d'utilisation de ces ressources ; et
- D'organiser une répartition équitable entre tous les États parties des avantages qui résulteront de ces ressources, une attention spéciale étant accordée aux intérêts et aux besoins des pays en développement, ainsi qu'aux efforts des pays qui ont contribué, soit directement, soit indirectement, à l'exploration de la Lune.

D'autres dispositions du Traité sur l'espace sont également reprises dans l'Accord sur la Lune, par exemple l'interdiction des armes nucléaires et des armes de destruction massive à l'article 3 ainsi que, à l'article 7, l'obligation de « prendre des mesures pour éviter de perturber l'équilibre existant du milieu en lui faisant subir des transformations nocives, en le contaminant dangereusement par l'apport de matière étrangère ou d'une autre façon ». Ce dernier article contient également un nouvel aspect, car certaines régions de la Lune qui présentent un intérêt scientifique particulier peuvent être désignées comme « réserves scientifiques internationales » pour lesquelles on conviendra d'accords spéciaux de protection. On pourrait imaginer cela, par exemple, pour la face cachée de la lune, afin de protéger les observations des radioastronomes.

Malgré ces notes positives, il faut dire que l'Accord sur la Lune n'est pas, à ce jour, déterminant dans l'établissement d'un régime juridique pour l'utilisation des ressources spatiales. Il est donc important d'analyser la tendance à l'adoption d'une législation nationale dans ce domaine. Les réglementations nationales apportent-elles plus de clarté, et sont-elles en accord avec le droit international ?

18 Voir R. Lefeber, « Relaunching the Moon Agreement », *Air and Space Law*, vol. 46, n° 1, 2016, pp. 41–48.

2 L'Etat du Droit : Les Législations Nationales

Les premières législations en matière d'utilisation de ressources spatiales sont celles des États-Unis et du Luxembourg. Il est intéressant de se pencher également sur les développements plus récents dans d'autres pays. Il apparaît que l'absence de clarté au niveau du droit international mène les états à légiférer de façon unilatérale, afin d'apporter une certaine sécurité juridique à leur industrie nationale.

2.1 La loi américaine

La *Commercial Space Launch Competitiveness Act* (*CSLCA*) a été adoptée le 25 novembre 2015[19]. Elle comprend quatre titres, dont le quatrième est intitulé *Space Resource Exploration and Utilization*, dont la section 51303 dispose que :

> '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'.[20]

La loi prévoit expressément que les États-Unis n'exercent aucune souveraineté, droit souverain ou exclusif, ni juridiction ou droit de propriété sur un corps céleste, garantissant ainsi le respect l'article II du Traité de l'espace. En effet, comme ce traité ne contient pas d'interdiction explicite de l'utilisation de ressources, on peut en déduire que l'utilisation des ressources spatiales est autorisée, et que la loi américaine est une interprétation possible du Traité sur l'espace, même s'il reste à savoir si et dans quelle mesure cette interprétation sera partagée par d'autres États[21].

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19 *Commercial Space Launch Competitiveness Act*, H.R. 2262, 114th Congress (2015-2016). Voir également F. Tronchetti, « Title IV - Space Resource Exploration and Utilization of the US Commercial Space Launch Competitiveness Act: A legal and political assessment », *Air and Space Law*, vol. 41, n° 2, 2016, pp. 143–156.

20 « Un citoyen des États-Unis engagé dans la récupération commerciale d'une ressource d'astéroïde ou d'une ressource spatiale en vertu du présent chapitre a droit à toute ressource d'astéroïde ou ressource spatiale obtenue, y compris pour posséder, transporter, utiliser et vendre la ressource d'astéroïde ou la ressource spatiale obtenu conformément à la loi applicable, y compris les obligations internationales des États-Unis ».

21 Voir *Position paper on space mining*, *op. cit.* note 14. Voir aussi T. Masson-Zwaan & B. Richards, « Op-ed | International Perspectives on Space Resource Rights », *SpaceNews*, 8 décembre 2015.

Bien que cette législation soit un pas en avant audacieux et sans précédent pour l'avenir des activités liées aux ressources spatiales, il ne fournit aucun processus ou mécanisme clair pour établir comment les entreprises peuvent être protégées des autres opérateurs (nationaux ou étrangers) qui interfèrent avec leur activité prévue ou en cours. De plus, le Congrès n'a pas encore décidé quelle agence du gouvernement américain aura le pouvoir d'autoriser les activités de ressources spatiales, ou même toute activité privée sur la Lune[22]. Un seul permis en vertu de la loi américaine a été accordé[23]. D'autres missions lunaires qui n'impliquent pas l'utilisation de ressources lunaires, mais n'en sont pas moins uniques, ont été autorisées récemment[24]. Toutefois, la mise en œuvre concrète de l'article VI du Traité sur l'espace par le gouvernement américain reste en suspens.

Un autre développement législatif dans ce domaine a eu lieu en octobre 2020, quand la NASA a publié les Accords Artemis comme base juridique du programme Artemis, partenariat international d'agences spatiales voué au retour des humains sur la Lune d'ici 2024[25]. Ces Accords doivent garantir que toutes les activités liées à Artemis seront conformes aux principes fondamentaux du droit international et aux « meilleures pratiques » identifiées. Les termes plus détaillés de la coopération de la NASA avec des agences spatiales particulières seront consignés dans des accords bilatéraux distincts[26]. Les obligations issues des accords reviendront ensuite à toutes les agences ou autres parties agissant au nom des États contractants, y compris les entreprises privées[27]. L'Australie (un des États membres de l'Accord sur la Lune), le Canada, l'Italie, le Japon, le Luxembourg, les Émirats arabes unis et le Royaume-Uni ont signé le document le 13 octobre 2020. D'autres États ont été invités à adhérer aux accords en soumettant leur signature au gouvernement des États-Unis[28]. L'Ukraine a répondu favora-

22 Voir Masson-Zwaan & Sundahl, *op. cit.* note 10.

23 B. Richards, « US Government approves Plan for Moon Express to Become First Private Company to Venture Beyond Earth's Orbit », *Cision*, 3 August 2016 https://www.prnewswire.com/news-releases/us-government-approves-plan-for-moon-express-to-become-first-private-company-to-venture-beyond-earths-orbit-300308628.html. Sur la mise en œuvre de l'article VI, voir M. Sundahl, « Regulating non-traditional Space Activities in the United States in the Wake of the Commercial Space Launch Competitiveness Act », *Air and Space Law*, vol. 42, n° 1, 2017, pp. 29–42.

24 La compagnie Astrobotic lancera sa première mission Peregrine fin 2021, et amènera par exemple des cendres humaines et d'animaux ou encore des capsules avec des messages d'enfants sur la surface lunaire. Voir https://www.astrobotic.com/manifest.

25 Accords Artemis, Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes, 13 October 2020, https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf.

26 *Ibid*. s. 2.1

27 *Ibid*. s. 2.1 (4).

28 *Ibid*. s. 13.3. Sur le cas de l'Australie, voir F. Tronchetti, H. Liu, « Australia's Signing of the Artemis Accords: a Positive Development or a Controversial Choice? », *Australian Journal of International Affairs*, vol. 75, n° 3, 2021, pp. 243-251.

blement à cette invitation le 15 novembre 2020[29] tandis que le processus d'adhésion est en cours pour le Brésil[30] et la Corée du Sud[31]. En plus du fait qu'une grande partie de son contenu est tirée des traités existants, les accords semblent encourager le multilatéralisme. Dans la section 10, par exemple, les accords exigent de ses signataires qu'ils participent au développement multilatéral du droit international « y compris par les efforts en cours au CUPEEA »[32]. En janvier 2021, les États-Unis ont notifié les Accords Artemis à l'ONU, en demandant au Secrétaire-Général de faire circuler la lettre et le texte des accords à tous les membres de l'ONU, tout en précisant qu'ils n'étaient pas éligibles à l'enregistrement comme un traité ou accord international en vertu de l'article 102 de la Charte de l'ONU[33].

Les Accords Artemis introduisent aussi quelques idées nouvelles pour mettre en œuvre les obligations du Traité de l'espace dans un contexte opérationnel. Parmi les idées les plus innovantes figure le concept de « zones de sécurité » qu'un État déclarerait autour de ses opérations. La définition de ces zones dans la section 11 des accords précise qu'elles revêtent un caractère informatif, afin d'éviter les interférences[34]. Certains craignent que les États-Unis n'aient l'intention de traiter les zones de sécurité comme leur propriété exclusive en violation du Traité de l'espace[35]. Ces craintes semblent contredites par la section 11 (7) laquelle indique que les zones doivent être limitées en taille et en portée ; de même, la section 11 (11) confirme le principe de libre accès aux corps célestes.

En septembre 2020, la NASA a sollicité des devis auprès plusieurs entreprises souhaitant se rendre sur la Lune et vendre entre 50 et 500 grammes de roches lunaires ou de régolithe. Une fois que l'entreprise aurait recueilli l'échantillon et fourni des preuves, la NASA prendrait possession de l'échantillon et payerait l'entreprise. La société n'aurait pas à renvoyer l'échantillon sur Terre, laissant la NASA le collecter lors d'une future mission[36]. En décembre 2020, la NASA a contracté avec quatre

29 Voir https://ua.usembassy.gov/ukraine-becomes-the-9th-country-to-sign-the-artemis-accords/.

30 Une déclaration d'intention a été signée le 14 décembre 2020 : https://www.nasa.gov/feature/nasa-administrator-signs-statement-of-intent-with-brazil-on-artemis-cooperation.

31 Park Si-Soo, « South Korea to Join NASA's Artemis Project: Reports », *Space News*, 18 mai 2021, https://spacenews.com/south-korea-to-join-nasas-artemis-project-reports.

32 Section 10.4 des Accords Artemis.

33 Assemblée générale des Nations Unies, *Coopération internationale touchant les utilisations pacifiques de l'espace*, Lettre datée du 30 décembre 2020, adressée au Secrétaire général par la Représentante permanente des États-Unis d'Amérique auprès de l'Organisation des Nations Unies, UN Doc. A/75/699, 7 janvier 2021.

34 Section 11.7 des Accords Artemis.

35 Voir, par exemple A. Boley & M. Byers, « U.S. Policy Puts the Safe Development of Space at Risk », *Science* 174, 9 October 2020.

36 J. Foust, « NASA Offers to Buy Lunar Samples to Set Space Resources Precedent », *Space News*, 10 September 2020.

entreprises pour une somme totale de vingt-cinq mille dollars[37]. Il semble que le but principal de cette opération serait de créer un précédent pour l'extraction et le transfert de ressources lunaires, plutôt que d'obtenir réellement les ressources demandées à des fins lucratives. Cependant, cette opération aidera certainement à démontrer la faisabilité de l'extraction des ressources et stimulera cette industrie naissante.

De même, le récent succès de « MOXIE », une expérience NASA pour extraire de l'oxygène de l'atmosphère de Mars qui pourra servir de carburant et pour soutenir la vie sur la planète rouge, démontre que l'utilisation des ressources est bien imminente, et qu'un cadre juridique devient de plus en plus urgent[38].

2.2 La loi luxembourgeoise

Le Luxembourg a adopté une loi comparable à celle des États-Unis en 2017[39]. Celle-ci dispose dans son article premier que « les ressources de l'espace sont susceptibles d'appropriation ». Cette loi se limite à l'exploration et à l'utilisation des ressources spatiales et ne couvre pas l'autorisation et la surveillance des activités spatiales, ni l'enregistrement des objets lancés en orbite. Une loi supplémentaire relative à ces questions plus générales a récemment été adoptée[40]. Ces deux textes servent de base juridique à l'autorisation et au contrôle des activités spatiales du Luxembourg.

Concernant la loi de 2017, le Conseil d'État luxembourgeois, dans un avis publié le 7 avril 2017, avait reconnu qu'une loi nationale ne peut pas fournir de certitude alors que le droit international contient des ambiguïtés, et que d'autres États ne reconnaîtront pas le droit national luxembourgeois[41]. Cette critique, qui paraît justifiée, s'applique également à la situation américaine, et constitue un argument convaincant dans le cadre de la conclusion d'un accord international.

37 Les entreprises concernées sont : Lunar Outpost du Colorado, Masten Space Systems de Californie, Ispace Europe du Luxembourg, Ispace Japan de Tokyo. Voir https://www.nasa.gov/press-release/nasa-selects-companies-to-collect-lunar-resources-for-artemis-demonstrations.

38 Nasa, « NASA's Perseverance Mars Rover Extracts First Oxygen from Red Planet », Press release, 21 April 2021.

39 Loi du 20 juillet 2017 *sur l'exploration et l'utilisation des ressources de l'espace*, Journal officiel du Grand-duché de Luxembourg, n° 674.

40 Loi du 15 décembre 2020 *portant sur les activités spatiales*, Journal officiel du Grand-Duché de Luxembourg, n° 1086.

41 J.-M. Gaudron, J.-M. Hennebert, « Le Conseil d'État garde les pieds sur terre », *PaperJam*, 11 avril 2017.

2.3 Les développements législatifs aux Émirats arabes unis, au Japon et en Chine

D'autres États ont également adopté ou sont en cours d'adopter une législation afin d'accueillir et d'encourager les activités liées aux ressources spatiales. Au Japon, une loi a été adoptée en juin 2021, lequel prévoit d'autoriser la possession des ressources spatiales à ceux qui les ont collectées, sur la base de plans d'exploration soumis à l'avance au Premier ministre[42]. La loi japonaise vise à encourager les entreprises nationales à développer leurs activités dans ce domaine. On rappellera que le Japon a adhéré aux Accords Artemis en octobre 2020.

Les Émirats arabes unis (ci-après EAU), également signataires des Accords Artemis, ont adopté une loi relative au secteur spatial en 2019[43]. Son article 18 revient sur « l'exploration, l'exploitation et l'utilisation des ressources spatiales ». Il donne au Conseil des ministres le pouvoir de délivrer des permis « pour l'exploration, l'exploitation et l'utilisation des ressources spatiales, y compris leur acquisition, achat, vente, commerce, transport, stockage et toute activité spatiale visant à fournir des services logistiques à cet égard ». L'article confirme que l'extraction de ressources spatiales est autorisée selon l'interprétation du droit international par les EAU et que les ressources extraites peuvent appartenir à des entités privées.

En janvier 2021, la Chine a dévoilé une réglementation sur la gestion des échantillons lunaires, encourageant la coopération internationale sur l'étude des échantillons rapportés par la sonde Chang'e-5. Publiée par la *China National Space Administration* (*CNSA*), la réglementation couvre les principes généraux de conservation, de gestion, d'utilisation, d'emprunt et de retour des échantillons lunaires, ainsi que la diffusion d'informations et la gestion des résultats de recherche des échantillons. Selon la réglementation, les échantillons lunaires seront généralement utilisés à quatre fins : le stockage permanent, le stockage permanent de sauvegarde, la recherche et le bien-être public[44]. La Chine a bien l'intention d'établir une permanence lunaire, comme en témoigne la conclusion d'un accord avec la Russie récemment pour la construction de l'*International Lunar Research Station* (*ILRS*)[45].

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42 *Law Concerning the Promotion of Business Activities Related to the Exploration and Development of Space Resources*, voir J. Foust, « Japan Passes Space Resources Law », *SpaceNews*, 17 juin 2021. Voir aussi, J. Kyodo, « Japanese bill to allow ownership of samples from outside Earth », *Japan Times*, 6 November 2020, et Nishimura Institute of Advanced Legal Studies, *Report by the Space Resource Development Laws Study Group*, 2016, 32 p.

43 *UAE Federal Law No. (12) of 2019 on the Regulation of the Space Sector*, issued on 19 December 2019.

44 Voir « China encourages international cooperation on lunar sample study », *Xinhuanet*, 18 janvier 2021.

45 A. Jones, « China, Russia enter MoU on international lunar research station », *Space News*, 9 mars 2021. Voir aussi, du même auteur : « China, Russia open moon base project to international partners, early details emerge », *ibid*., 26 avril 2021.

Même si ces lois semblent converger vers une légitimité des activités liées aux ressources spatiales et le besoin de les faciliter tout en les réglementant, le recours à l'instrument législatif national pose un problème en droit international. D'une part, la législation nationale ne peut pas être invoquée contre d'autres États. D'autre part, elle comporte un risque de fragmentation du droit international. Dès lors, si ces premières lois étaient peut-être une étape nécessaire pour rassurer l'industrie émergente et encourager les discussions internationales, elles ne peuvent constituer une solution durable à long terme. En effet, il serait tout à fait préjudiciable au succès de cette nouvelle activité spatiale que de nombreux autres pays empruntent la voie législative dans ce domaine. Il faudrait plutôt envisager une coordination internationale pour parvenir à un ensemble de règles lequel bénéficiera et protégera toutes les parties prenantes.

3 Un Nouveau Cadre Juridique International ?

Étant donné que les traités existants n'apportent aucune réponse claire, et que l'adoption de lois nationales présente également certains problèmes, il serait préférable de créer un nouveau cadre normatif international. Comme l'adoption d'un nouveau traité n'est pas probable dans le contexte global actuel, un instrument non contraignant peut être envisagé, pour ensuite le rendre contraignant pour les entreprises concernées au moyen d'un système de licences en vertu du droit national. Il convient donc d'envisager la possibilité d'un nouveau cadre juridique international.

3.1 Le rôle du CUPEEA

Il y a quelques années que le sujet de la réglementation des activités des ressources spatiales figure sur l'agenda du sous-comité juridique du CUPEEA[46]. Quelques mois après l'adoption de la loi américaine en 2015, le sous-comité scientifique et technique s'est réuni, et ensuite le sous-comité juridique du CUPEEA a eu lieu. Certains États ont critiqué les États-Unis et d'autres États qui envisageaient d'adopter une telle législation nationale, comme le Luxembourg et les Émirats arabes unis. Par exemple, selon la Russie, le CUPEEA est le seul forum international pour le développement du droit spatial, et les États ne devraient pas adopter de lois unilatéralement dans un domaine de compétence du CUPEEA[47]. Lors de la session du sous-comité juridique, un nouveau point de l'ordre du jour a été adopté

46 Voir un résumé plus complet chez Masson-Zwaan & Sundahl, *op. cit.* note 10.

47 Voir par ex. Comité des utilisations pacifiques de l'espace extra-atmosphérique, « Examen des possibilités existantes pour parvenir à Vienne, en matière de sécurité spatiale, à un consensus portant sur différents domaines de réglementation », *Document de travail présenté par la Fédération de Russie*, A/AC.105/L.304, 16 mars 2016, par. 7 notamment.

à la suggestion de la Belgique, intitulé « Échange de vues général sur les modèles juridiques potentiels pour les activités d'exploration, d'exploitation et d'utilisation des ressources spatiales ». La question a été abordée pour la première fois en 2017, et a été reconduite depuis. En 2017, les délégations ont fait peu de déclarations de fond ; elles avaient une attitude plutôt passive, sauf certaines comme la Belgique qui a déclaré qu'elle ne voyait aucun intérêt à différencier les corps célestes de leurs ressources naturelles aux fins de leur régulation, et a demandé :

> 'What would be the purpose of prohibiting national appropriation of celestial bodies while allowing the same nations to exclusively determine the use of their resources, surely the most valuable and, hence contentious, part of celestial bodies? What would be the point of reserving celestial bodies' use to a universal purpose while letting some nations with the highest technological development take all the benefit of their resources?'[48].

En 2018, des critiques ont été exprimées au sujet de l'adoption des lois nationales. Ainsi, la formation d'un groupe de travail *ad hoc* a été proposée, en vain[49]. En 2019, la plupart des délégations étaient d'avis qu'un cadre juridique international pour les activités relatives aux ressources spatiales était nécessaire. La discussion n'était dès lors plus tellement centrée sur la légitimité de l'utilisation des ressources, mais plutôt sur ses modalités et sa gouvernance[50]. Des principes comme l'utilisation durable ou la prévention de contamination ont été évoqués, ainsi que le besoin de normes internationales de sécurité appropriées et une coordination internationale pour éviter les conflits. La délégation des Pays-Bas a informé le sous-comité des travaux du groupe de travail international de La Haye sur la gouvernance

48 « Quel serait le but d'interdire l'appropriation nationale des corps célestes tout en permettant aux mêmes nations de déterminer exclusivement l'utilisation de leurs ressources, la partie la plus précieuse et donc la plus controversée des corps célestes ? Quel serait l'intérêt de réserver l'utilisation des corps célestes à un objectif universel tout en laissant certaines nations au développement technologique le plus élevé tirer tous les bénéfices de leurs ressources ? », Committee on the Peaceful Uses of Outer Space, *Contribution from Belgium to the discussion under UNCOPUOS Legal Subcommittee on item General exchange of views on potential legal models for activities in exploration, exploitation and utilization of space resources* (notre traduction), A/AC.105/C.2/2017/CRP.19, 28 March 2017. Pour un aperçu des réactions des différents États, voir les présentations de O. Bittencourt Neto et Th. Cheney lors du colloque sur les aspects juridiques de l'utilisation des ressources spatiales qui s'est tenu à Leiden le 17 avril 2016 : https://www.universiteitleiden.nl/en/events/2016/04/symposium-on-legal-aspects-of-space-resource-utilisation.

49 Committee on the Peaceful Uses of Outer Space, *Questions and observations by Belgium on the establishment of national legal frameworks for the exploitation of space resources*, Working Paper prepared by Belgium, A/AC.105/C.2/2018/CRP.8, point 3.

50 Comité des utilisations pacifiques de l'espace extra-atmosphérique, *Rapport du Sous-Comité juridique à sa cinquante-huitième session*, 2019, UN Doc. A/AC.105/1203, pars. 239–267, https://www.unoosa.org/oosa/oosadoc/data/documents/2019/aac.105/aac.1051203_0.html.

des ressources spatiales[51]. Plusieurs délégations ont indiqué que ces travaux étaient d'une grande importance et que l'examen des *Building Blocks for the Development of an International Framework on Space Resource Activities*, issus de ce groupe contribuerait considérablement aux discussions dans le sous-comité[52]. La création d'un groupe de travail du sous-comité a été proposée à nouveau en 2019, sans qu'il ne soit possible de parvenir à un accord. Cependant, le sous-comité a décidé de tenir des « consultations informelles programmées » et nommé deux modérateurs en 2020 pour les diriger. Ces derniers ont présenté un projet de plan pour ces consultations aux États membres, contenant les thèmes proposés pour la discussion. Le but de ces consultations serait d'avoir un échange de vues large et inclusif sur les futures délibérations concernant l'exploitation et l'utilisation des ressources spatiales, y compris la création éventuelle d'un groupe de travail.

La session de 2020 a été annulée à cause de la COVID-19. Celle de 2021 a eu lieu en mode virtuel pour la plus grande majorité des délégations. Les consultations informelles prévues sur les ressources spatiales ont eu lieu, mais même si au bout des discussions il y eu un consensus pour établir un groupe de travail, aucun consensus n'a pu être atteint sur le mandat de ce groupe, ni sur ses termes de référence, ce qui le laisse dans un état assez ambigu. Il a été décidé que du temps sera réservé lors de la réunion du comité principal en août 2021, pour que le groupe de travail puisse finaliser ces points[53].

Il est clair que le sous-comité juridique du CUPEEA constitue l'enceinte adéquate pour travailler sur la question de la réglementation des activités des ressources spatiales, et il est regrettable que la proposition de constituer un groupe de travail n'ait pu aboutir jusqu'à présent, faute de consensus.

Il faut admettre qu'historiquement, la prise de décision au CUPEEA a été plutôt lente et lourde, et la question est de savoir si un accord sur un nouveau traité ou un instrument non contraignant peut être atteint en temps voulu. Seules des résolutions non contraignantes ont été adoptées depuis l'Accord sur la Lune de 1979. Pourtant, ce phénomène de *soft law* n'est pas nécessairement problématique, car les principes contenus dans ces résolutions pourraient, à terme, devenir coutumiers si sont réunis une pratique des États et une *opinio juris* suffisantes, et devenir ainsi contrai-

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51 Committee on the Peaceful Uses of Outer Space, *The Hague Space Resources Governance Working Group, Information provided by the Netherlands*, UN Doc A/AC.105/C.2/2018/CRP.18,

52 Même si la Belgique n'admettait pas la légitimité du groupe, en observant : « *In the absence of any actual mandate received from States and of a formal mechanism ensuring their representation, Belgium does not acknowledge such initiatives as providing a "forum for negotiations on an international framework". We regret that the work of some experts, though potentially valuable, has been undertaken in a manner that, eventually, creates confusion and generates interference with the work of UNCOPUOS* », Paper prepared by Belgium, *op. cit.* note 49, point 2. Pour plus de détails sur les travaux du groupe, voir III B.

53 Voir rapports provisoires, UN Doc A/AC.105/C.2/L.314/Add.2 et UN Doc A/AC.105/C.2/L.314/Add.8.

gnants pour les États[54]. En outre, la législation spatiale nationale inclut souvent une obligation pour les entités privées de se conformer à ces instruments, ce qui les rend contraignants en vertu du droit interne.

Or, parvenir d'à un accord au sein du CUPEEA sur une résolution, un code de conduite, des lignes directrices ou toute autre forme d'instrument non contraignant sur l'exploitation des ressources spatiales sera difficile. Le nombre d'adhésions au CUPEEA n'a cessé de croître, passant d'une vingtaine d'États en 1959 à près de cent aujourd'hui, parmi lesquels certains n'ont pas encore de capacité spatiale, mais sont en voie de devenir des puissances dans ce domaine. Cet accroissement rend la recherche d'un consensus de plus en plus compliquée, comme l'a démontré l'adoption récente des lignes directrices sur la durabilité à long terme des activités spatiales, qui aura pris près de dix ans. En outre, les entités non gouvernementales, telles que les entreprises, ne peuvent participer officiellement aux réunions du CUPEEA, alors qu'il serait tout à fait essentiel d'entendre la voix de ces parties prenantes comme principaux acteurs de cette nouvelle activité. Dans ce contexte, il est utile de rappeler l'exemple de l'Union Internationale des Télécommunications, qui compte en plus de ses 193 États membres, plus de 900 entités du secteur privé et établissements universitaires en tant que « Membres de Secteur »[55]. Il semble peu probable que le CUPEEA adopte cette pratique dans un futur proche, bien qu'il soit souhaitable de l'envisager.

Pour les diverses raisons exposées ci-dessus, il serait peut-être préférable d'essayer d'abord de parvenir à un accord en dehors du CUPEEA avant d'essayer d'envisager la question de manière globale, ou au moins d'avancer les réflexions dans d'autres forums pour préparer et faciliter les discussions au Comité.

3.2 D'autres forums

Ces dernières années, plusieurs groupes non gouvernementaux ont proposé des éléments, principes et autres considérations pour alimenter la discussion[56]. Le Groupe de travail international sur la gouvernance des ressources spatiales de La Haye, fondé en 2016 à l'Institut international de droit aérien et spatial de l'Université de Leiden, est un exemple de forum informel dans lequel toutes les parties prenantes, y compris les entreprises concernées, ont joué un rôle. Le but de ce groupe de travail était d'évaluer la nécessité

54 Voir Article 38 du Statut de la Cour Internationale de Justice. Voir aussi I. Marboe (ed.), *Soft law in outer space: the function of non-binding norms in international space law*, Wien, Böhlau, 2012, 407 p.

55 Voir https://www.itu.int/fr/about/Pages/membership.aspx.

56 V aussi les *Best Practices for Sustainable Lunar Activities* de la Moon Village Association (MVA) ; les *Vancouver Recommendations on Space Mining* et *Open Letter on Space Mining* du Outer Space Institute (OSI). V. enfin plusieurs documents et rapports de Open Lunar Foundation. Voir pour un aperçu, Masson-Zwaan & Sundahl, *op. cit* note 10.

de réglementer les activités liées aux ressources spatiales et, si nécessaire, d'encourager les États à négocier un accord international ou un instrument juridiquement non contraignant. Le groupe a travaillé pendant quatre ans à l'identification et au développement d'un nombre de modules et a conclu ses travaux à fin 2019 avec l'adoption de vingt *Building Blocks for the Development of an International Framework on Space Resources Governance*[57].

Ces *Building Blocks* ou modules visent à fournir une base pour de futures négociations potentielles sur un cadre pour régir les activités relatives aux ressources spatiales. Un Commentaire sur les modules a été publié en 2020 afin de fournir des informations générales sur leur formulation et pour analyser les fondements juridiques et la discussion derrière chaque disposition[58]. Le groupe de travail de La Haye a estimé qu'un futur cadre international devrait créer un environnement propice aux activités relatives aux ressources spatiales qui tienne compte de tous les intérêts et profite à tous les pays et à l'humanité.

Ces modules sont basés sur le concept de « gouvernance adaptative », ce qui signifie qu'ils n'ambitionnent pas d'aborder tous les aspects de la question dès le départ, mais sont supposés évoluer sur la base d'une compréhension mutuelle croissante. En atteste parfaitement la circonstance que les modules ne traitent que de l'utilisation des ressources dans l'espace extra-atmosphérique, et non de leur retour éventuel sur terre. Les modules intègrent des perspectives techniques, juridiques, scientifiques, industrielles, commerciales et sociales, reflétant ainsi le caractère multiforme de l'utilisation des ressources spatiales. Ils incluent des définitions de termes clés, des dispositions concernant l'accès et les droits sur les ressources spatiales, les mesures de sécurité liées aux activités liées aux ressources spatiales, la prévention et l'atténuation de leur impact potentiellement nocif,

57 Pour plus d'informations sur le groupe de travail, comme des liens vers les rapports finaux, le texte des modules, les rapports de réunion, les listes de membres et d'observateurs, etc., voir https://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-of-air-space-law/the-hague-space-resources-governance-working-group. Cinq articles de mise à jour ont été publiés entre 2017 et 2020 : T. Masson-Zwaan *et al.*, « The Hague Space Resources Governance Working Group : A Progress Report », *Proceedings of the International Institute of Space Law 2016*, Eleven 2017, pp. 163 et suivantes ; T. Masson-Zwaan *et al.*, « The Hague Space Resources Governance Working Group: Second Progress Report », *Proceedings of the International Institute of Space Law 2017,* Eleven, 2018, pp. 281 et suivants ; T. Masson-Zwaan *et al.*, « The Hague Space Resources Governance Working Group: Third Progress Report», *Proceedings of the International Institute of Space Law 2018,* Eleven 2019, pp. 761 et suivants ; T. Masson-Zwaan et al., « The Hague international space Resources Governance Working group: Final Progress report », *70th International Astronautical Congress*, IAC-19-D4.5.1, 2019 ; *ibid.*, « The Hague International Space Resources Governance Working Group: Conclusion and Way Forward », *71st International Astronautical Congress*, IAC-20-D4.5.1, 2020.

58 O. de O. Bittencourt Neto, M. Hofmann, T. Masson-Zwaan, D. Stefoudi (eds.), *Building Blocks for the Development of an International Framework for the Governance of Space Resource Activities: a Commentary*, The Hague, Eleven International Publishing, 2020, 164 p.

le partage des bénéfices des activités liées aux ressources spatiales et un certain nombre de dispositions générales. Ils comprennent également des dispositions concernant l'attribution de droits de priorité aux opérateurs pour rechercher et/ou récupérer des ressources spatiales *in situ* pendant une durée déterminée et dans une zone limitée sous condition d'enregistrement dans un registre international, ainsi que la création de zones de sécurité pour assurer la sécurité et d'éviter toute interférence nuisible avec d'autres activités.

En 2020, les Pays-Bas et le Luxembourg ont soumis les modules au sous-comité juridique du CUPEEA. Ces derniers pourront par conséquent être pris en compte lors des consultations informelles à venir[59]. L'influence de ces modules est encore faible, bien qu'ils aient déjà inspiré des initiatives ultérieures, comme les Accords Artemis[60]. Il est encourageant de voir que la nouvelle génération de décideurs reprend les suggestions des modules et les approfondit, en lisant le rapport publié récemment par un groupe de travail du *Space Generation Advisory Council*, nommé *Action Team on Effective and Adaptive Governance for a Lunar Ecosystem* (E.A.G.L.E)[61]. Ce rapport sera présenté lors de la session du sous-comité juridique du CUPEEA en juin 2021. Il analyse l'état actuel du paysage politique lunaire et propose le développement d'une charte globale de gouvernance lunaire (*Lunar Charter*). L'objectif de cet instrument serait de rendre opérationnels les principes fondamentaux du droit international de l'espace et de permettre l'élaboration progressive de nouveaux principes.

Il faut espérer que toutes ces initiatives contribueront à l'émergence d'un consensus dans le CUPEEA, de sorte qu'un régime international pour les activités relatives aux ressources spatiales en résultera.

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Il est clair que le *corpus juris spatialis* n'apporte aucune réponse formelle et internationalement reconnue à toutes les questions soulevées par les nouvelles activités spatiales comme l'utilisation commerciale des ressources. Toutefois, les traités et les résolutions fournissent un cadre global qui garantit l'utilisation pacifique de l'espace depuis plus de cinquante ans, permettant à l'humanité d'exploiter les possibilités infinies que l'espace offre.

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59 Comité des utilisations pacifiques de l'espace extra-atmosphérique, *Modules pour l'élaboration d'un cadre international régissant les activités axées sur les ressources spatiales*, Document de travail présenté par le Luxembourg et les Pays-Bas, UN Doc A/AC.105/C.2/L.315, 3 février 2020.

60 Des représentants de la NASA et du *Department of State* avaient participé aux travaux du groupe.

61 Space Generation Advisory Council, E.A.G.L.E., *Effective and adaptive governance for a lunar ecosystem*, 10 May 2021, 50 p.

Le Traité de l'espace n'autorise pas explicitement l'exploitation commerciale des ressources spatiales par des entités privées et ne répond pas à toutes les questions, mais ne l'interdit pas non plus[62]. Un travail supplémentaire sera certainement nécessaire pour la réglementation de l'exploitation des ressources spatiales, et prendra, de préférence, la forme d'un accord international le plus large possible, de préférence au sein du CUPEEA. L'Accord sur la Lune ne laisse pas beaucoup d'espoir pour apporter une solution, compte tenu de l'état décevant du nombre de ratification obtenues, mais il ne peut être exclu que les projets actuels d'exploitation spatiale conduisent à multiplier les ratifications de cet Accord ; après tout, les États qui accèdent à l'Accord auront leur mot à dire dans le régime international qu'il prescrit.

Même si l'objectif ultime de toute entreprise commerciale est de faire des bénéfices, le travail de pionnier dans le domaine des ressources spatiales se traduira sans aucun doute par des avantages pour l'humanité tout entière. Toutefois, l'exploitation des ressources spatiales ne sera réussie que lorsque les obligations internationales des États au titre du Traité de l'espace seront respectées, que les ajouts et clarifications nécessaires auront été convenus au niveau international, et que toutes les parties prenantes pourront partager les bénéfices de façon équitable et durable.

62 Quelques années auparavant, au cours de discussions aux États-Unis sur un éventuel amendement de certaines parties du traité, tous les participants ont fait valoir que cela n'était ni souhaitable ni nécessaire ; le gouvernement, les entreprises et les universitaires ont fait l'éloge du traité, tout en indiquant qu'il pourrait être clarifié et complété par d'autres moyens, tels que des lignes directrices ou un code de conduite. Voir J. Foust, « Companies, Lawyers Argue Against Changing Outer Space Treaty », *SpaceNews*, 26 mai 2017.

IX Human Spaceflight*

1 Introduction

This chapter will address two kinds of human presence in outer space. First, it will discuss orbital spaceflight, focusing mainly on the International Space Station (ISS). The ISS has hosted professional astronauts since 2000, and several paying passengers between 2001 and 2009. Before the ISS, there have been a few other stations where astronauts have lived and worked, but the ISS is the first international venture and presents the most interesting legal questions. Secondly, sub-orbital flights will be addressed, and some of the many unresolved legal questions this raises will be highlighted. Contrary to orbital flights, sub-orbital flights with paying passengers have not yet happened. This activity has promising prospects that go beyond bringing wealthy individuals to the edge of space, as it may be the first step towards point-to-point transportation via outer space.

2 Orbital Human Spaceflight

2.1 The International Space Station

Several 'space stations' have orbited the Earth since the 1970s, but at the time of writing only the International Space Station (ISS) and the Chinese Tiangong 2 are still operational.[1] The ISS is a prime example of successful international cooperation in the exploration and use of outer space for

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* *Introduction to Space Law*, T. Masson-Zwaan and M. Hofmann (Kluwer, 2019), pp. 79-95.

1 Predecessors to ISS were Skylab (1973–1979), Salyut 7 (1982–1991), Mir (1986–2001), and Tiangong 1 (2011–2018). Tiangong 2 was launched in 2016 and is likely to be de-orbited in 2019, according to a report in Space News, 27 Sept. 2018, *see* https://spacenews.com/china-could-be-facing-space-station-delay-tiangong-2-to-be-deorbited/. Plans for a new, permanently crewed version of Tiangong were announced in Nov. 2018, *see* http://www.spacedaily.com/reports/China_unveils_new_Heavenly_Palace_space_station_as_ISS_days_numbered_999.html (all websites cited in this chapter were last accessed and verified on 6 Nov. 2018). The Russian Mir was the first 'modular' station. i.e. assembled in space, like the ISS.

peaceful purposes.[2] The plan for a space station was initiated by President Reagan of the United States in 1984 and a first Intergovernmental Agreement was concluded in 1988, but not until Russia joined the partnership in 1998 did construction really begin. The ISS has been permanently inhabited since October 2000.[3] In 2009, the number of crew on board increased from three to six, and two Soyuz capsules are now constantly docked to the station to bring the crew home in case of an emergency. Operation of the ISS is currently foreseen until 2024.

The ISS is a civil station for peaceful purposes built and operated by five Partners: the USA, eleven Member States of the European Space Agency (ESA) forming the European Partner,[4] Russia, Japan and Canada, and their space agencies (NASA, ESA, the Russian agency Roscosmos, the Japanese Aerospace Exploration Agency JAXA and the Canadian Space Agency CSA). It is as large as a football field and can be seen in the sky when it passes over at an altitude of approximately 400 km.[5] The ISS serves many different peaceful purposes, such as scientific research, development of applications in space, demonstration of new technologies, education, commercial activities, as a platform for space exploration missions, and even as a deployment facility to place small satellites into orbit.

Since the US Space Shuttle was retired in 2011, the Russian Soyuz has been the only launch vehicle capable of transporting humans to and from the station.

The legal framework governing the ISS is unique. The fifteen States signed a multilateral treaty named the ISS 'Intergovernmental Agreement' (IGA) on 28 January 1998.[6] A second layer of agreements consists of Memoranda of Understanding (MOU), between NASA and the four other space agencies. At the third level, there are bilateral implementation agreements. A few features of the IGA are highlighted below.

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2 For general information about the ISS, *see* e.g. the webpages of ESA and NASA dedicated to the ISS at http://www.esa.int/esaHS/iss.html and http://www.nasa.gov/mission_pages/station/main/index.html. For the legal aspects of ISS, *see* F. Lyall & P. Larsen, *Space Law: A Treatise* 110–114 (2nd ed., Routledge 2018), C. Sharpe & F. Tronchetti, *Legal aspects of public manned spaceflight and space station operations*, in F. von der Dunk & F. Tronchetti (eds.), *Handbook of Space Law* 618–661 (Elgar 2015) and F.G. von der Dunk & M. Brus (eds.), *The International Space Station: commercial utilization from a European Legal Perspective* (Brill 2006).

3 The previous record was held by Mir (10 years minus 8 days).

4 They are Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland, and the UK (the latter contributes since 2011). For ESA, this is a so-called 'optional programme' to which not all Member States have to contribute, only if they choose to.

5 *See* https://spotthestation.nasa.gov/sightings/ to find upcoming space sighting opportunities for any location.

6 The ISS IGA can be accessed via https://www.state.gov/documents/organization/107683.pdf. *See also* https://www.esa.int/Our_Activities/Human_Spaceflight/International_Space_Station/International_Space_Station_legal_framework.

2.2 Compliance with International Law

First, it is not the aim of this agreement to replace the international legal framework put in place under the auspices of the United Nations,[7] nor to replace other instruments and rules of public international law. Instead, Article 2 of the IGA provides that the ISS is to be operated in accordance with international law. In several instances, reference is made to specific provisions of the UN space treaties, and all Partners are a party to at least four of those treaties.[8]

2.3 Registration

Article II of the Registration Convention requires the launching State to enter a space object it launches into 'an appropriate registry', and when there are two or more launching States, they shall jointly determine who will register the object, and may conclude agreements about jurisdiction and control over the object and any personnel thereof (paragraph 2). To comply with this treaty obligation, Article 5 of the IGA settles the question of registration of the flight elements of the Space Station as follows.

Each Partner shall register as space objects the flight elements it provides. This implies that each flight element is a 'space object' and each Partner retains jurisdiction and control over its flight elements. This is in accordance with Article VIII of the Outer Space Treaty and Article II of the Registration Convention. The European Partner has delegated the responsibility to register to its Cooperating Agency, ESA, acting in its name and on its behalf. ESA is entitled to do so pursuant to its Declaration of Acceptance of the Registration Convention. As such, the ISS is a 'patchwork' of different jurisdictions.

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7 This framework consists of the following treaties: (i) 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 Dec. 1966, entered into force on 10 Oct. 1967, 610 UNTS 205 (hereafter also referred to as OST or Outer Space Treaty), *see* Annex 1; (ii) Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, adopted on 19 Dec. 1967, entered into force on 3 Dec. 1968, 672 UNTS 119 (hereafter also referred to as ARRA or Rescue Agreement), *see* Annex 2; (iii) Convention on International Liability for Damage Caused by Space Objects, adopted on 29 Nov. 1971, entered into force on 1 Sept. 1972, 961 UNTS 187 (hereafter also referred to as LIAB or Liability Convention), *see* Annex 3; (iv) Convention on Registration of Objects Launched into Outer Space, adopted on 12 Nov. 1974, entered into force on 15 Sept. 1976, 1023 UNTS 15 (hereafter also referred to as REG or Registration Convention), *see* Annex 4; and (v) Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, adopted on 5 Dec. 1979, entered into force on 11 July 1984, 1363 UNTS 3 (hereafter also referred to as MOON or Moon Agreement), *see* Annex 5. *See also* the extensive analysis of these treaties in Ch. 2.

8 As of 1 Jan. 2018, the USA, Russia, Japan and Canada were parties to all treaties except MOON. The same applies to the eleven Members who participate in the ISS, except that the Netherlands and Belgium also ratified MOON. ESA has made declarations of acceptance to REG, LIAB and ARRA.

2.4 Liability Waivers

An innovative feature is Article 16 of the IGA, addressing liability. Of course, the liability provisions of the UN space treaties also apply, as far as damage caused by or to the ISS by non-partners is concerned. Specifically, fault liability would apply for damage caused in outer space as per Article III of the Liability Convention. However, this does not pertain to damage that might be caused by one ISS Partner to another. In order not to endanger the ISS cooperation by a situation where Partners would bring multiple claims against each other, the IGA contains a so-called 'cross-waiver' of liability among the Partners through Article 16. This means that each Partner agrees not to hold the others liable in case of damage.

The waiver does not apply in case of wilful misconduct, personal injury or claims related to intellectual property, and it must be flowed down to the entire chain of contractors and subcontractors. So far there have been no claims for damage caused to or by the ISS by or to external parties, nor among the Partners.

2.5 Intellectual Property Rights

Intellectual property rights are the subject of Article 21 of the IGA, which provides that an activity occurring in or on a flight element is deemed to have occurred in the territory of the Partner State of that element's registry. For instance, a patent for an invention made on the Japanese laboratory module may be filed anywhere in the world, but Japan will be considered as the State where the invention originally took place. For the European Partner this again presents a complication, and it was decided that any European Partner State may extend its national law to the European elements and consider the activity to have occurred within its territory. In theory, an invention occurring in the European Columbus laboratory module could thus be deemed to have occurred in any of the eleven European States participating in the ISS program, insofar as it has made its national law applicable to the Columbus module.

2.6 Criminal Jurisdiction

Criminal jurisdiction is elaborated in Article 22 of the IGA. It states that in principle the State of nationality of the alleged perpetrator of a criminal act has jurisdiction to prosecute, but if it fails to do so within a reasonable period, the State of nationality of the victim has the right to do so. The IGA may serve as extradition agreement.[9] This provision has not yet been put to the test.

9 This is often done to facilitate extradition, as most States refuse to extradite their nationals unless an extradition treaty exists.

2.7 Use of the ISS

Looking at users' rights and the possibility of allowing commercial use of the ISS, neither the IGA nor the MOU's contain explicit references to commercial utilisation, but they do provide that each Partner may use equipment and facilities in or on each other Partner's elements in accordance with their respective 'utilisation rights' as per Article 9 IGA. Partners may barter or sell any portion of its allocation to other partners – or even non-partners if the others agree.[10]

2.8 Crew

Each Partner is allowed to assign astronauts to serve as crew on board the ISS. Under Article V of the Outer Space Treaty, astronauts are called 'envoys of mankind', and they enjoy the right to assistance in case of accident, distress or emergency landing under the provisions of the Rescue Agreement. However, those rules do not establish any 'chain of command' on board a space station, and therefore Article 11 of the IGA provides that a Crew Code of Conduct should be established for that purpose. This Code was adopted in 2000 and establishes such a chain of command and specifies the rules, standards and responsibilities that crew must abide by from the moment they are assigned to a certain mission until the end of post-flight requirements. For example, crew members may carry mementos, such as flags or patches, i.e., small items of minor value, but these may not be sold, transferred for sale, used or transferred for personal gain or used or transferred for any commercial or fundraising purpose. Personal effects like a wristwatch are not considered mementos.

In 2001, the Multilateral Crew Operations Panel (MCOP) adopted the 'Principles Regarding Processes and Criteria for Selection, Assignment, Training and Certification of ISS (Expedition and Visiting) Crewmembers', which introduced the category of 'spaceflight participants', as opposed to professional astronauts and cosmonauts, in order to provide for visitors

10 *See* R. Veldhuyzen & T. Masson-Zwaan, *ESA Policy and Impending Legal Framework for Commercial Utilisation of the European Columbus Laboratory Module of the ISS* in F. von der Dunk & M. Brus (eds.), *supra* n. 2 at 47–62.

wishing to experience a stay in an orbital space station.[11] Seven wealthy individuals have thus visited the ISS between 2001 and 2009, as the Russian Partner sold spare seats on the Soyuz transportation vehicle for a price ranging between twenty and forty million US dollars, via the company Space Adventures.[12] When the ISS crew doubled from three to six in 2009, this was no longer possible.

The Commander of the Station is responsible for ensuring the crew's safety and health, maintains order and implements disciplinary regulations, enforces procedures for security operations and protects equipment and payloads on board the Station. It is however the flight director on the ground who has overall responsibility for the mission, operations and decisions.

2.9 The Future

As stated above, for the time being it is the intention of the Partners to operate the ISS until 2024. It could probably even be kept operational for a longer time, and one option is to gradually transfer some of the responsibilities to the private industry, although crew health and safety are likely to remain under government control.[13] But commercial entities are already involved in other ways. The US company Nanoracks has been deploying cubesats from the ISS since many years. Another example of involvement of the private industry is the Bigelow Expandable Activity Module (BEAM)

11 Spaceflight participants are defined as 'individuals (e.g. commercial, scientific and other programs, crewmembers of non-partner space agencies, engineers, scientists, teachers, journalists, filmmakers or tourists), sponsored by one or more partner(s); normally this is a temporary assignment that is covered under a short-term contract.' They are eligible for assignments as visiting scientist, commercial user or tourist, but their task assignment cannot include ISS assembly, operations and maintenance activities. On the other hand, a professional astronaut/cosmonaut is defined as 'an individual who has completed the official selection and has been qualified as such at the space agency of one of the ISS partners and is employed on the staff of the crew office of that agency'. Only professional astronauts/cosmonauts are eligible for assignment as crew commander, pilot, flight engineer, station scientist or mission specialist. The Principles are available at https://www.esa.int/Our_Activities/Human_Spaceflight/International_Space_Station/ISS_partners_release_crew_criteria_document.

12 *See* http://www.spaceadventures.com. Initially, the company MirCorp, incorporated in the Netherlands, was planning to facilitate private space travel to Mir, and had actually already signed a contract with Dennis Tito who later became the first paying passenger to ISS. But eventually Russia decided to deorbit Mir and partner with the USA and others instead, in order to build the ISS. *See* about MirCorp, http://mircorp.org/index.html. It is still uncertain whether private trips to ISS will happen again in the future, but Space Adventures still proposes the 'ISS experience' on its website.

13 D. Werner, *Trump wants NASA out of the ISS operations business. Easier said than done*, Space News, 5 July 2018. http://spacenews.com/trump-wants-nasa-out-of-the-iss-operations-business-easier-said-than-done/.

that docked with the Station in 2016.[14] Supply missions to the ISS are carried out by SpaceX and Boeing under contract with NASA, of course with the approval of the other Partners. In the future they will also handle crew transportation, but the certification of commercial vehicles capable of carrying crew to the Station is likely to be delayed. This may increase the dependency on the Russian partner beyond the agreed timeline, and may affect access to the ISS.[15]

Before the Station spins out of control at the end of its useful life, a decision on de-orbiting it during a controlled re-entry will have to be taken by the Partners; this will be a very complex operation requiring careful preparation.[16]

At the same time, work has already started on a follow-up programme, named 'the Gateway', to be placed in the vicinity of the moon as a kind of outpost, to provide shelter, relay communications, and stock supplies for astronauts traveling to more distant destinations and also serving as a research facility.[17] It is meant as a (much smaller) follow-up to ISS, involving the same international partners, but also private industry. One of the questions that arises in terms of legal and policy aspects of such a multinational cooperative venture is whether the ISS model can serve as an example for future endeavours, such as a mission to the Moon or Mars. It is clear that the experience gained with the ISS is of huge importance for any future major international cooperation in the use and exploration of space, despite the financial, technological and legal hurdles it had to overcome.[18] The ISS has demonstrated that States can work together in space despite political tensions on Earth, and the benefits, expertise and knowledge generated by the ISS for humankind are immense.[19]

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14 *See* https://www.nasa.gov/mission_pages/station/research/experiments/1804.html.

15 The US GAO (Government Accountability Office) has estimated that 'Boeing and SpaceX could miss their current schedules for having their commercial crew vehicles certified by NASA by a year or more, creating a gap in access to the station when the agency's use of Soyuz seats ends late next year', *see* J. Foust, *Commercial crew delays threaten access to ISS, GAO warns*, Space News, 11 July 2018, https://spacenews.com/commercial-crew-delays-threaten-access-to-iss-gao-warns/.

16 *See also* Ch. 8 on space debris.

17 *See* e.g. https://www.esa.int/Our_Activities/Human_Spaceflight/Exploration/Space_gateway or https://www.nasa.gov/feature/nasa-s-lunar-outpost-will-extend-human-presence-in-deep-space.

18 The IISL dedicated several sessions to the topic of space station, such as in 1999 in Amsterdam, *Legal aspects of space station utilization* (AIAA 2000), in 2002 in Houston, *ISS and the Law* (AIAA 2003), and in 2014 in Toronto, *The ISS IGA: Lessons Learned and Looking to the Future* (Eleven 2015).

19 It has been proposed to nominate the ISS for the Nobel Prize, *see* W. Peeters, *ISS as a Nobel Peace Prize Nominee? Why Not?* Space News, 17 Feb. 2014, http://spacenews.com/39540iss-as-a-nobel-peace-prize-nominee-why-not/.

3 Sub-Orbital Flights

3.1 Introduction

Ever since the Ansari X-prize in 2004[20], several companies have been preparing the technology for commercial sub-orbital flights for private individuals.[21] Sub-orbital flight in itself is not a new activity. For instance, sounding rockets are used to conduct experiments in microgravity and ballistic missiles carry warheads. But what is new is using this technology to send paying individuals into outer space – or is it airspace? Are these vehicles rockets or planes, and are the persons they will carry 'astronauts' or just passengers on board an aircraft? What laws should apply? Much has been written about the legal aspects of sub-orbital flights for private individuals,[22] but no concrete answers are available.

UNCOPUOS has been debating the topic of definition and delimitation of outer space since several decades, but has not come up with a solution – partly because some States prefer to leave the question open for political reasons.[23] So the question remains open at the level of international law, while some States have started to provide for a boundary in their national law. With the advent of sub-orbital flights, this question becomes of more practical relevance than ever before. States need to know how to address and regulate this new activity, and struggle with issues like safety, licensing

20 *See* http://ansari.xprize.org. The prize aimed 'to challenge teams from around the world to build a reliable, reusable, privately financed, manned spaceship capable of carrying three people to 100 kilometers above the Earth's surface twice within two weeks'.

21 During a sub-orbital flight, orbital velocity is not achieved. Vehicles usually attain an altitude of around 100 km, then shut down their engine resulting in three to minutes of microgravity, after which the vehicle re-enters the atmosphere and returns back to Earth.

22 *See* e.g T. Masson-Zwaan & R. Moro-Aguilar, *Regulating private human sub-orbital flight at the international and European level: tendencies and suggestions*, 92 Acta Astronautica 243–254 (2013); T. Masson-Zwaan & S. Freeland, *Between heaven and earth: The legal challenges of human space travel*, 66 Acta Astronautica 1597–1607 (2010); T. Masson-Zwaan, *Regulation of Sub-orbital Space Tourism in Europe: A Role for EU/EASA?*, 35 Air and Space Law 263–272 (2010); R. Moro-Aguilar, *National Regulation of Private Suborbital Flights: A Fresh View*, 10 FIU L. Rev. 679–711 (2015); Lyall & Larsen, *supra* n. 2 at 227–234, F. von der Dunk, *Legal aspects of private manned spaceflight*, in F. von der Dunk & F. Tronchetti, *Handbook of Space Law*, *supra* n. 2 at 662–716, S. Hobe, G. Goh & J. Neumann, *Space Tourism Activities – Emerging Challenges to Air and Space Law?*, 33 JSpaceL 359–373 (2007); F. von der Dunk, *Passing the Buck to Rogers: International Liability Issues in Private Spaceflight,* 86 Nebraska Law Review 400–438 (2007), S. Hobe, *Legal Aspects of Space Tourism*, *ibid*. at 439; and S. Freeland, *Up, up and Back: The Emergence of Space Tourism and its Impact on the International Law of Outer Space*, 6 Chicago J Int. L. 1–22 (2005). The IISL dedicated several sessions to the topic of sub-orbital flights, e.g. in 2007 in Hyderabad, *Legal issues of private spaceflight and space tourism* (AIAA 2008), in 2011 in Cape Town, *Legal issues of commercial human spaceflight*, (Eleven 2012) and in 2014 in Toronto, *Legal issues associated with private human flight, including space and ground facilities, traffic management and spaceports* (Eleven 2015).

23 On the discussions in UNCOPUOS on the definition and delimitation of outer space, *see* Ch. 1, §1.05, and relevant documents at http://www.unoosa.org/oosa/en/ourwork/copuos/lsc/ddos/index.html.

or certification requirements. At the same time, industry is concerned about the lack of clarity regarding for instance liability exposure, insurance implications and passengers' rights. The two leading companies in this field are Virgin Galactic and Blue Origin.[24]

The concept of Virgin Galactic involves a launch of six passengers and two pilots on board 'SpaceShipTwo', which separates at 15.000 meters from the mothership 'WhiteKnightTwo'. The total flight duration is around two hours, during which passengers will float for several minutes in zero-gravity before 'gliding' back to Earth to its home base, Spaceport America in New Mexico.[25] In the future, flights will also be planned from elsewhere.[26] The tickets cost 250,000 US dollars, and more than six hundred passengers have reportedly already signed up and made initial payments.

Blue Origin's concept is different, its 'New Shepard' resembles a capsule which is fixed on top of a rocket. The ten-minute flight will transport six passengers, and returns to Earth by means of parachutes and retrorockets. Tickets are not yet on sale and prices have not been announced yet, but the company expects to start doing so in 2019.[27]

Looking at the applicable law, if flights do not cross borders, i.e. if they take off and land in one State, national law would apply. Insofar as sub-orbital flights would have trans-boundary effect, i.e., take off and land in different States, national law may still apply if there is no applicable international law or bilateral agreement. The current options would be to apply either international air law or international space law to such international flights. However, their characterisation as either aviation or space activity remains unclear, and both regimes have some positive and negative aspects. For instance, space law is incomplete in terms of rules on carrier liability, crew and passengers, whereas air law is so comprehensive that it may hinder the new industry. In the next paragraphs, these scenarios will be analysed further.

3.2 National Law

Many of the currently planned sub-orbital flight companies plan to operate from one territory only, at least initially, and this will most likely be the USA. As long as the vehicles 'take off' and 'land' in the same State, that State's

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24 *See* http://www.virgingalactic.com/ and https://www.blueorigin.com/new-shepard. Several others had advanced plans but ended their activities, most notably XCOR Aerospace, which filed for bankruptcy in 2017, *see* http://spacenews.com/xcor-aerospace-files-for-bankruptcy/.

25 *See* http://www.spaceportamerica.com.

26 A second spaceport may be opened at an airport in the south of Italy, *see* I. Couronne, *First space tourist flights could come in 2019,* Space Daily, 13 July 2018, http://www.spacedaily.com/reports/First_space_tourist_flights_could_come_in_2019_999.html.

27 J. Foust, *Blue Origin plans to start selling sub-orbital spaceflight tickets next year,* Space News, 21 June 2018, https://spacenews.com/blue-origin-plans-to-start-selling-sub-orbital-spaceflight-tickets-next-year/.

national law will apply. In addition, as long as there is no international regime that has been agreed to apply to sub-orbital activities, each State has the right to regulate human sub-orbital flights launching from and operated within its territory according to its own preferences, and hence it is free to decide whether these flights are to be considered as aviation or rocket launches,[28] possibly adapting existing regulatory frameworks to the specific needs of sub-orbital flights.

3.2.1 USA

The United States was the first State to develop specific rules for sub-orbital flights. The US approach was to grant power for regulation and licensing over this activity to the Federal Aviation Administration's Office of Commercial Space Transportation (FAA/AST).[29] A 'light touch' legal approach was taken, where the main concern is public safety and safety of property. This means that sub-orbital vehicles have to be licensed like launch vehicles, and not certified like aircraft. On the other hand, passengers are required to accept the risk and may not hold operators liable in case of damage or injury. The law qualifies paying passengers as 'spaceflight participants', and operators must inform them of the risks and notify them that the US Government has not certified the vehicle as safe. Passengers must then provide their 'informed consent' in writing in order to participate in the flight.[30]

This 'light touch' approach was chosen in order to allow the new industry to make a start. FAA/AST was in fact given a double mandate: (i) to oversee,

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28 This is known as the 'Lotus principle' which says that within its territory, a State may exercize its jurisdiction in any matter, even if there is no specific rule of international law permitting it to do, subject of course to prohibitive rules of international law, or, in short, 'that which is not prohibited is permitted under international law'. *The Case of the S.S. Lotus*, 7 Sept. 1927, PCIJ Series A n. 70.

29 51 USC 50901–50923. The Commercial Space Launch Act of 1984, as amended in 2004, was re-codified in USC Title 51 ('National and Commercial Space Programs'), Ch. 509 ('Commercial Space Launch Activities') Secs. 50901-50923, available at http://uscode.house.gov/browse/prelim@title51&edition=prelim. The Act mandated the FAA/AST to regulate sub-orbital flights. The FAA commercial space transportation regulations are located in the Code of Federal Regulations (CFR), Title 14 ('Aeronautics and Space'), Ch. III ('Commercial Space Transportation'), available at https://www.govinfo.gov/content/pkg/CFR-2018-title14-vol4/xml/CFR-2018-title14-vol4-chapIII.xml. Some relevant parts are 14 CFR 401 (organization and definitions), 415 (launch license), 431 (launch and re-entry of re-usable launch vehicles-RLV's), 435 (re-entry of non-RLVs), 440 (financial responsibility) and esp. 460 (national Astronautical Congress, gress, r as aviation of space he acquis communautaire'ansferred their sovereign rights to regulauman spaceflight requirements). *See also* http://www.faa.gov/about/office_org/headquarters_offices/ast/regulations/.

30 T. Knutson, *What is 'informed consent' for spaceflight participants in the soon-to-launch space tourism industry?* 33 JSpaceL 105 (2007). It may be questionable whether injured passengers or their relatives will be bound by such letters in practice, cf. also Lyall & Larsen, *supra* n. 2 at 120.

authorize, and regulate both launches and re-entries of launch and re-entry vehicles, and the operation of launch and re-entry sites when carried out by US citizens or within the USA in order to ensure public health and safety, safety of property, and the national security and foreign policy interests of the United States, and (ii) to encourage, facilitate, and promote commercial space launches and re-entries by the private sector, including those involving space flight participants. This dual mandate may sound conflicting, but if the FAA had only been in charge of ensuring safety, a process might have resulted 'that will make sure you're safe by not letting you fly'.[31]

The US law does not define whether sub-orbital flights are space flights or something else. It regulates according to the type of vehicle involved.

3.2.2 Others

Looking at Europe, before looking at national law it is first necessary to establish whether the European Union (EU) has competence in this field or whether Member States retain their sovereign power to legislate.

With regard to space activities, the entry into force of the Treaty on the Functioning of the European Union (TFEU) in 2009 codified the competence of the EU in the field of space activities. However, the powers of the EU are limited to scientific and technological space activity and likely do not cover private commercial space activities such as sub-orbital flights. In addition, the harmonization of national space laws and regulations is prohibited under paragraph 2 of Article 189 of the TFEU.[32] There is thus, for the time being, no EU competence to regulate sub-orbital flights as spaceflight, and Member States are free to regulate them as aviation or as space activity. They might consider sub-orbital vehicles more akin to spacecraft and regulate them under their national space legislation, but currently, only a few European States have adopted space legislation, and none of them addresses sub-orbital flight.[33] On the other hand, since human sub-orbital flight will be substantially carried out in airspace, it is possible that the civil aviation authorities concerned will take the lead and consider sub-orbital flights under the aviation rules, which is what happened in the UK, as will be seen *infra*.

With regard to aviation, the EU does not have an exclusive competence. The EU has established an extensive set of rules under the *acquis communautaire*.[34] If the EU would consider sub-orbital flight as coming under the

31 J. Foust, *Still waiting on space tourism after all these years*, The Space Review, 18 June 2018, http://www.thespacereview.com/article/3516/1.

32 *See* T. Masson-Zwaan, *supra* n. 22, and T. Masson-Zwaan & S. Freeland, *ibid.*, at 1597–1607.

33 *See* for a useful overview of national space legislation, http://www.oosa.unvienna.org/oosa/en/SpaceLaw/national/state-index.html. Only the Dutch Space Activities Act makes a brief mention to an eventual inclusion within its scope of commercial human space activities, in its Art. 2.2.b.

34 *See* P. Mendes de Leon, *Introduction to air law*, Ch. 3 (10th ed., Kluwer 2017).

aviation *acquis*, the EU aviation rules would become applicable, as well its competence in the field of safety regulation via the European Aviation Safety Agency (EASA). EASA would be at the forefront to ensure the safety of sub-orbital flight in Europe and might require full certification for commercial sub-orbital vehicles, instead of the licensing approach chosen by the USA, unless it decides to grant an exception for sub-orbital vehicles and applies a softer regime, as is allowed under its mandate. However, despite some initial involvement, the EU has so far not declared its intention to regulate sub-orbital flights under its aviation regime.[35]

ESA has expressed its view on this matter in 2008, when it presented an official position paper on privately-funded sub-orbital spaceflight.[36] The paper provides the following definition of 'space tourism': 'the execution of sub-orbital flights by privately-funded and/or privately-operated vehicles and the associated technology development driven by the space tourism market.' ESA observed that, since sub-orbital space tourism 'will be carried out substantially in the airspace of a given country', the civil aviation authorities concerned and the competent agencies of the EU should be at the forefront for setting up a regulatory framework for space tourism in Europe. It also stated that 'since in the longer term space tourism will involve travelling to outer space, some rules of space law may find application for space tourism'. This seems to imply that ESA sees the currently foreseen sub-orbital flights as an aviation activity to which air law must be applied, and would at a later stage look at the possible application of space law for the regulation of orbital space tourism.[37] Since then, ESA has not given further statements on the matter.

In the meantime, the United Kingdom is the second State that has taken action to regulate sub-orbital flights. The UK presented an ambitious draft Spaceflight Bill in 2017, which led to the adoption of the Space Industry Act in March 2018, henceforth referred to as 'the Act'.[38] The aim of the Act is to enable the launch of small satellites from the UK, as well as sub-orbital spaceflights and scientific experiments. The first UK spaceport should be operational before 2020 and it is expected that licences for launch and sub-orbital activities will be granted around that time. The Act will be accompanied by a regulatory structure that 'empowers innovation,

35 *See* J.B. Marciacq e.a., *Towards regulating sub-orbital flights – an updated EASA approach,* 61st International Astronautical Congress, Prague, 2010 and J.B. Marciacq e.a., *Accommodating sub-orbital flights into the EASA regulatory system*, in J. Pelton & R. Jakhu (eds.), *Space safety regulations and standards* 187–212 (Springer 2010).

36 *See* press release at http://www.esa.int/esaCP/SEM49X0YUFF_index_0.html, with a link to the position paper.

37 . d the event pages at t interest of all stakeholders, whether they are States, operators of passengers.ok of Space Law, 5) ight T. Masson-Zwaan & R. Moro-Aguilar, *supra* n. 22.

38 *See* https://services.parliament.uk/bills/2017-19/spaceindustrybill.html. Following agreement by both Houses on the text of the Bill, it received Royal Assent on 15 March 2018 and the Bill is now an Act of Parliament (law).

embraces opportunity and ensures UK launch activity is carried out safely and responsibly in the UK'.[39]

The UK Civil Aviation Authority will be in charge of licensing sub-orbital flights, and the regulations will resemble those of the US, in the sense that the safety of the uninvolved general public is the primary concern, while at the same time the intent is to not place burdens on industry that would stifle its development and growth. The concept of 'informed consent' is included in Article 17 of the Act.

As more national laws will start to address sub-orbital flights, deciding to choose either an air law approach or a space law approach, a patchwork of different rules may result, leading to flags of convenience and forum shopping. It seems desirable that some measure of harmonization takes place, in the best interest of all stakeholders, whether they are States, operators of passengers. In any case it is interesting that both the USA and the UK have decided to regulate sub-orbital flight activities in their space legislation and not in their aviation legislation.

3.3 International Law

When sub-orbital flights will eventually involve more than one State, for instance in transit or when picking up or delivering passengers or cargo, international law will apply, but it is uncertain whether this would be air law or space law. The UN space law treaties apply to relations between States in carrying out space activities, whereas international air law conventions deal with international carriage by air. There are many differences between air law and space law, mainly because air law is based on the complete sovereignty of the State over the airspace above its territory, while space law is based on the principle of freedom of use and exploration, and rules out claims of sovereignty.

The legal regime governing aviation is very elaborate, efficient and well defined in terms of liability, registration, jurisdiction, traffic- and transit rights, certification of aircraft and crew, and other matters, and the rules have been tested and clarified by jurisprudence.[40] So if sub-orbital flights were considered as aviation, there would be no major problems or lack of rules, but there may be a measure of regulatory overkill that might hinder the emerging industry. If, however it would be considered as a space activity and would consequently be governed by space law, the legal scenario will be quite different and gaps may exist, because the rules are far less detailed and mostly regulate the relations between States, and they have never been put to the test in a court case.

Perhaps in the end, the establishment of a new *sui generis* regime for sub-orbital flights, mixing elements from the air law and space law regimes, might be the preferred option.

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39 *Ibid*.

40 P. Mendes de Leon, *supra* n. 34.

3.3.1 *Applying Space Law*

International space law is not very well suited to accommodate sub-orbital activities. The Outer Space Treaty did foresee that private entities would engage in space activities in Art. VI of the Outer Space Treaty, making States internationally responsible for national activities carried out by non-governmental entities, obliging them to authorize and supervise such activities. But the UN treaties do not clearly define what qualifies as a 'space object', so it is unclear whether sub-orbital vehicles could qualify as such. Likewise, the treaties only address liability at the level of the States involved, and the exposure of private operators to second- or third-party liability is not addressed.[41] The only relevant references to persons on board vehicles is in Article V OST which defines them as 'envoys of mankind', and ARRA which speaks of 'personnel of a spacecraft', but does not distinguish between crew and paying passengers. Also, there is no cap on liability, and no opportunity for passengers or third parties to present claims for compensation directly to the operator. Claims must be presented by one State to another. Moreover, nationals of the launching State may be excluded altogether from presenting a claim under Article VII of the Liability Convention. This provision is inadequate for a paying passenger on board a commercial flight.

Space law also presents problems with regard to the registration of the vehicles, since Article II of the Registration Convention mentions that only objects that are launched 'into Earth orbit or beyond' are to be registered, and sub-orbital vehicles do not reach orbital velocity.

3.3.2 *Applying Air Law*

Air law forms a comprehensive legal regime, reinforced by subsequent improvements and accompanied by extensive interpretation by case law.[42] There may be certain benefits in applying international air law to international sub-orbital flights, but this would also present difficulties.

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41 Second-party or contractual liability refers to liability of the operator vis-à-vis passengers and cargo, while third-party or non-contractual (tort) liability refers to liability for damage to persons or property on the ground, who have no contractual relations with the activities of the operators.

42 The main legal instruments are the Convention on International Civil Aviation, Chicago, 7 Dec. 1944 (Chicago Convention), the Convention for the Unification of Certain Rules Relating to International Carriage by Air, Warsaw, 12 Oct. 1929 (Warsaw Convention), the Convention for the Unification of Certain Rules for International Carriage by Air, Montreal, 28 May 1999 (Montreal Convention), and the Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface, Rome 7 Oct. 1952, amended 1978 (Rome Convention). *See* for the Chicago Convention https://www.icao.int/publications/pages/doc7300.aspx and for the private air law conventions, https://www.mcgill.ca/iasl/research/treaties/airlaw/private. . d the event pages at t interest of all stakeholders, whether they are States, operators of passengers.ok of Space Law, 5) ight

The classic definition of 'aircraft' in the Annexes to the Chicago Convention does not adequately cover sub-orbital flights, which use rocket power. Sub-orbital flights could be regulated by air law only in case of a wide interpretation of the term 'aircraft'. This would bring legal certainty, which is essential for the industry. Another benefit is applicability of the operator-based liability system, which provides efficient protection and procedures for passengers and third parties.

Another advantage of applying air law is that sub-orbital vehicles could be registered as aircraft, whereas under the Registration Convention they cannot be registered as spacecraft, because they do not reach orbit.

Contrary to space law, air law consists of both public air law and private air law, where the former regulates aviation in respect of safety, security and traffic regulation, and the latter addresses second- and third-party liability of the operator vis-à-vis passengers and third parties on the ground. This provides a more complete set of rules to deal with various legal matters. Space law is purely public law, setting out the relations between States.

The downside of applying international air law is that operators of sub-orbital flights would have to comply with numerous rules, which may negatively impact the new industry and create heavy burdens. Air law has developed and changed considerably over the years; at first it was a State activity subject to many rules, and then gradually evolved into a privatized commercial activity requiring less protection. Sub-orbital flight is still in its infancy, and applying the full body of air law may be too demanding.

Over the years, the two UN bodies dealing with aviation and space have addressed the matter of regulating sub-orbital flights. This section provides a brief overview of their involvement.

Already in 2000, the President of the ICAO Council stated:

> 'The idea of adopting ICAO as a model, or expanding the mandate of ICAO to encompass outer space, has been raised before. This approach has merit. SARPs have proven effective in adapting to the dramatic transformation of civil aviation during the past 50 years or so. A global forum of nations is essential for achieving consensus on the management of outer space, and there already exists such a respected and time-honoured structure.'[43]

And in 2005, he suggested that ICAO would be the most appropriate organisation to regulate the safety of such sub-orbital flights. A Working Paper by the ICAO Secretariat observed:

> 'The Chicago Convention applies to international air navigation but current commercial activities envisage sub-orbital flights departing from and landing at the same place, which may not entail the crossing of foreign airspaces.

43 ICAO Journal Vol. 55, n. 7 (Sept. 2000).

> Should, however foreign airspace(s) be traversed, and should it be eventually determined that sub-orbital flights would be subject to international air law, pertinent Annexes to the Chicago Convention would in principle be amenable to their regulation.'[44]

In 2007, the Chairman of UNCOPUOS drafted a working paper on the 'Future role and activities of the Committee on the Peaceful Uses of Outer Space', containing proposals for a future role of COPUOS in analysing and regulating sub-orbital flights.[45] Also, there have been several interventions in the Legal Subcommittee under the agenda item on the definition and delimitation of outer space, addressing the impact of sub-orbital manned flights on current space law, while the concept of 'aerospace objects' has been analysed by the Legal Subcommittee since several decades.[46]

However, no concrete results have come out of the work of ICAO and UNCOPUOS so far, and the legal qualification of sub-orbital flights remains undefined until this day.

In order to make some progress, in 2015 the Directors of UNOOSA and ICAO's Air Navigation Bureau initiated the 'ICAO – UNOOSA Aero-SPACE Symposium' which took place in Montreal, Canada.[47] ICAO also set up a 'Space Learning Group' in late 2014, later joined by UNOOSA as official co-host of the group. The group has no formal status; it cannot draft standards or policies and is not a formal panel or study group. Its main activity is to share experiences and perspectives, to assess and take stock and then prepare next steps. The uniqueness of the learning group is that it integrates the aviation and space communities, and that it involves regulators, operators, lawyers, and scientists. An advantage of its informal character is that industry can also take part. The group is composed of experts appointed by Member States of ICAO and/or UNCOPUOS and representatives from several international organisations. ICAO also created a 'Space Programme' webpage, containing a list of 'Space Points of Contact & Knowledge Sharers', and documents and other resources provided by regulators, industry groups, and others engaged in the sector, searchable by State or subject.[48]

The symposium permitted to share and provide an overview of existing regulations and practices as well as safety management and systems

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44 C-WP/12436, Concept of Suborbital Flights, 30 May 2005, reprinted at http://www.unoosa.org/pdf/limited/c2/AC105_C2_2010_CRP09E.pdf. *See also* P. van Fenema, *Sub-orbital Flights and ICAO*, 30 Air and Space Law 396–411 (2005).

45 A/AC.105/L.268, 10 May 2007, http://www.oosa.unvienna.org/pdf/limited/l/AC105_L268E.pdf.

46 *See* n. 22.

47 *See* the event's website at http://www.icao.int/meetings/space2015/Pages/default.aspx. *See* for a report, T. Masson-Zwaan, *UN's Aviation and Space Bodies Meet in Montreal to Discuss Future Activities at the Intersection of Commercial Air and Space Travel*, 40 Air and Space Law 455–460 (2015).

48 *See* http://www4.icao.int/space.

engineering methods with regard to civil aviation, sub-orbital flights and developments in space transportation, to explore challenges and opportunities related to emerging space activities and provide possible ideas on how to address them, and to provide insight into space and civil aviation sectors, including who is doing what, how to get involved, and when and why aviation regulators are involved, and when they are not. A follow-up symposium was held in Abu Dhabi in 2016, and UNOOSA hosted the third event in 2017 in Vienna.[49] However, once again, no concrete results were achieved yet.

3.4 The Future

Under current international or national air or space law there is no definite answer yet about the legal status of sub-orbital flights. Also, despite all the excitement after the Ansari X-Prize, carrying humans on sub-orbital flights has proven to be more complex than initially thought. Several companies that seemed to have promising plans suffered delays or failed altogether, and possibly, the technical and financial challenges are even larger than the legal ones.[50] It seems that agreement could be found to apply part of the rules of air law to sub-orbital flights, while acknowledging their 'space' characteristics as well, so that some form of hybrid *sui generis* regime will eventually develop.

Hopefully, over time progress will be made in all related fields, so that the frontier of outer space can be made accessible to paying passengers, because the two companies that are 'leading the pack in the pursuit of space tourism say they are just months away from their first out-of-this-world passenger flights'.[51]

Another development is that although sub-orbital flights were initially marketed as spaceflight for private (wealthy) individuals, their potential to provide launch services for small satellites may take centre stage as a more viable business case. In 2017, Virgin Galactic even decided to create a separate company for this market, named Virgin Orbit.[52]

When the technological and financial hurdles will have been overcome by the pioneering industries and when ticket prices will come down, the number of potential clients will certainly be high because the prospect of experiencing weightlessness and observing the 'Blue Planet' from outer space is attractive to many. Moreover, eventually, sub-orbital flights will enable intercontinental rocket transport, i.e. flying from point A to point B on Earth via outer space, thus substantially shortening travel time.

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49 *See* the event pages at https://www.icao.int/meetings/space2016/Pages/default.aspx and . d the event pages at t interest of all stakeholders, whether they are States, operators of passengers.ok of Space Law, 5) ight https://www.icao.int/meetings/space2017/Pages/default.aspx.

50 J. Foust, *supra* n. 31.

51 I. Couronne, *supra* n. 26. *See also* J. Foust, *supra* n. 27.

52 *See* https://virginorbit.com.

4 Conclusion

Critics argue that human spaceflight is unnecessary, unsustainable, too dangerous and too costly, and all space activity can be carried out more efficiently and much cheaper by robots. The above reservations are certainly true, and sending humans into deep space will be a long time coming, but experts tend to agree that robotics and humans are both essential in exploring and using outer space: 'In what was really only a few days on the lunar surface, the Apollo astronauts produced a tremendous scientific legacy; robotic exploration of the moon and Mars pales in comparison'.[53]

Humans can quickly react to changing circumstances and are more mobile than robots, for instance. Another argument for having both is that robots can serve as pathfinders, preparing the grounds for human presence. And an aspect that should certainly not be underestimated is the role of astronauts as ambassadors for humankind. Only about five hundred persons have been to outer space since the start of the space age, and they always come back with a changed perspective – having observed the fragility of our planet Earth, and the absence of boundaries when seen from outer space, they have a message to convey. They motivate children to study science and math, so that they might one day become astronauts.

It may be clear that human presence in outer space is essential. It is furthermore mankind's nature to push boundaries. As Konstantin Tsiolkovsky, one of the fathers of rocketry and cosmonautics, once said: 'Earth is the cradle of humanity, but one cannot remain in the cradle forever'.[54] It is therefore important to continue to study the legal aspects of human spaceflight. The ISS will certainly be followed by further collaborative manned missions, whether it is a station or a settlement on the Moon or Mars. In addition, sub-orbital flights for private individuals will most certainly happen, and legal certainty will be needed.

53 A. Mann, *Humans vs. Robots: Who Should Dominate Space Exploration?*, Wired, 4 Nov. 2012, https://www.wired.com/2012/04/space-humans-vs-robots/, citing I. Crawford, *Dispelling the myth of robotic efficiency: why human space exploration will tell us more about the Solar System than will robotic exploration alone*, 53 Astronomy and Geophysics 2.22–2.26 (2012).

54 *See* https://www.nasa.gov/audience/foreducators/rocketry/home/konstantin-tsiolkovsky.html.

X Private Law Aspects of Suborbital Flights: Second- and Third-Party Liability and Insurance*

Abstract

Two companies carried private citizens to the edge of space in July 2021. Although suborbital flights have so far taken place within one jurisdiction – they start and end in the same state, do not pass through foreign airspace, or meet both criteria – they will become international when transportation between two points in different states via outer space becomes a reality. International law is ambiguous about the regulation of suborbital flights; neither international air law nor international space law explicitly apply. It is also unclear which organization or institution should be mandated with the international regulation of suborbital flights. The legal uncertainties must be solved to ensure a safe environment and a healthy industry. The characterization of suborbital flights as either aviation or spaceflight has important consequences, such as whether it concerns aspects of public law (e.g., safety) or private law (e.g., second- and third-party liability and insurance).

This Article focuses on the latter – the private law issues of second- and third-party liability insurance against such liability in the fields of both air and space law, illustrating the differences between the two and underlining the need for a solution.

When taking place within one jurisdiction, suborbital flights operating within a state's territory are properly subject to state regulation through national law, as this would purely be a national activity falling within a state's sovereign jurisdiction. Thus, states could decide to consider this activity as either aviation or spaceflight and apply air or space law accordingly. This may, however, lead to fragmentation and legal uncertainty. When flights become international by crossing borders on Earth, international agreement about what law should govern suborbital flights becomes critical and should be developed in close cooperation between the International Civil Aviation Organization (ICAO) and the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS). A new *sui generis* regime will likely borrow from both air and space law and insurance practices. Until such a regime under international law is adopted, national law will govern these issues. The only available model is U.S. law, which seems suitable for the short- to medium-term until an international regime emerges and the industry matures.

* *87 Journal of Air Law and Commerce* (2022) pp. 413-443; DOI: https://doi.org/10.25172/jalc.87.3.3

This Article will analyze current regimes and formulate recommendations for the way forward. Pursuant to that analysis, this Article concludes that a new international agreement on the operation of suborbital flights is required. For the time being, national law, harmonized to the maximum extent, should provide a solution. The Article further aims to identify relevant points for the establishment of national legislation and, in the longer term, an international agreement. Whether or not this will take the form of a legally binding instrument remains to be seen, although the latter seems more realistic in the current geopolitical context.

1 Introduction

Jeff Bezos of Blue Origin[1] and Richard Branson of Virgin Galactic[2] finally did it: in July 2021, within a few days of each other, they brought along several passengers on a trip to the edge of space.[3] Twenty-six teams took part in the Ansari X-Prize in 2004,[4] but only these two companies succeeded in having suborbital vehicles carry passengers to the threshold of outer space.[5] Interestingly, they used very different concepts of flight; Virgin Galactic launched a small vehicle named VSS (*Virgin Space Ship*) *Unity* from an aircraft named VMS (*Virgin Mother Ship*) *Eve*,[6] while Blue Origin vertically launched a single vehicle from the ground named *New Shepard*.[7]

Suborbital flights raise a myriad of legal questions. First and foremost, they take place at the border between air and outer space, but it is difficult to define this border.[8] At present, no official definition or delimitation exists

1 *See About Blue Origin*, Blue Origin, https://www.blueorigin.com/ (all sites in the article were accessed in August 2022).

2 *See generally Welcome to Virgin Galactic*, Virgin Galactic, https://www.virgingalactic.com/.

3 Caitlin O'Kane, *Billionaires Jeff Bezos and Richard Branson Have Now Both Gone to Space. Here's the Difference Between Their Blue Origin and Virgin Galactic Flights*, CBS News (July 20, 2021), https://www.cbsnews.com/news/blue-origin-bezos-launch-richard-branson-space-flight-differences/.

4 *See Launching a New Space Industry*, XPRIZE, https://www.xprize.org/prizes/ansari; *Mojave Aerospace Ventures Wins the Competition That Started It All*, XPRIZE, https://www.xprize.org/prizes/ansari/articles/mojave-aerospace-ventures-wins-the-competition.

5 A suborbital flight is a flight in which the vehicle reaches outer space, but its trajectory intersects the atmosphere or the surface of the Earth, so that it does not complete one orbital revolution; it falls back to the Earth instead. *See* John M. Horack, *What's a Suborbital Flight? An Aerospace Engineer Explains*, Conversation (July 9, 2021, 1:34 PM), https://theconversation.com/whats-a-suborbital-flight-an-aerospace-engineer-explains-164279.

6 *See* Chelsea Gohd, *Virgin Galactic Launches Richard Branson to Space in 1st Fully Crewed Flight of VSS Unity*, Space (July 11, 2021), https://www.space.com/virgin-galactic-unity-22-branson-flight-success.

7 *See* Blue Origin, *supra* note 1.

8 *See* Horack, *supra* note 5.

in international law.[9] It is unclear whether international air or space law could apply to suborbital activities.[10] The legal implications of the qualification of this new activity have been analyzed in detail,[11] but have not yet led to concrete answers.[12] For the United Nations' (UN) Outer Space Treaty to apply, reaching orbit is not explicitly required.[13] Even if it does apply, international space law has several shortcomings such as the registration; legal status; and liability of operators, crew, and passengers.[14]

As further elaborated in Section 2.A, applying international air law also presents difficulties because it is unclear whether the definition of "aircraft" contained in the Annexes to the Chicago Convention could cover rocket-powered vehicles.[15]

If suborbital flights do not cross borders, national law will apply.[16] 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,[17] 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.[18] Borders could be crossed, especially during flights originating in countries

9 Steven Freeland, *Keen to Sign Up for Space Tourism? Here Are 6 Things to Consider (Besides the Price Tag)*, Conversation (July 23, 2021), https://theconversation.com/keen-to-sign-up-for-space-tourism-here-are-6-things-to-consider-besides-the-price-tag-164940.

10 *See id.*

11 For a recent instance, see Anne-Sophie Martin & Steven Freeland, *A Round Trip to the Stars? Considerations for the Regulation of Space Tourism*, 47 Air & Space L. 261–284 (2022). For some earlier publications, see Tanja Masson-Zwaan & Steven Freeland, *Between Heaven and Earth: The Legal Challenges of Human Space Travel*, 66 Acta Astronautica 1597, 1605 (2010); Stephan Hobe, Géradine Meishan Goh & Julia Neumann, *Space Tourism Activities – Emerging Challenges to Air and Space Law?*, 33 J. Space L. 359, 363, 365–66 (2007).

12 See Masson-Zwaan & Freeland, *supra* note 11, at 1598.

13 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 Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty] (entered into force Oct. 10, 1967).

14 *See* Masson-Zwaan & Freeland, supra note 11, at 1602–04.

15 *See* Convention on International Civil Aviation, Dec. 7, 1944, 15 U.N.T.S. 295 [hereinafter Chicago Convention]. The Chicago Convention does not contain a definition of aircraft, but several of the Annexes to the Chicago Convention, which contain the Standards and Recommended Practices (SARPs), have a definition. Specifically, Annexes 7 and 8 define aircraft as "[a]ny machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface." Int'l Civ. Aviation Org. [ICAO], Aircraft Nationality and Registration Marks, at 1, ICAO Doc. Annex 7 (6th ed. 2012); ICAO, Airworthiness of Aircraft, at I-1, ICAO Doc. Annex 8 (12th ed. 2018). For a useful summary of the Annexes to The Chicago Convention, see ICAO, Annexes 1 to 18, [hereinafter Annexes Summary], https://www.icao.int/Documents/annexes_booklet.pdf, *see also infra* Part 2.

16 *See* Masson-Zwaan & Freeland, *supra* note 11, at 1600.

17 *See* Blue Origin, *supra* note 1.

18 *See* Gohd, *supra* note 6.

smaller than the United States such as those in Europe in which international law may apply.

So far, only a few states have started to regulate suborbital flights through national legislation,[19] and international law is still undecided about how to regulate suborbital flights.[20] It is becoming urgent to clarify the legal implications in terms of public law and address issues of safety, authorization, registration, and traffic management.

In terms of private law, the legal position of crew and passengers, liability, and insurance for damages to passengers and to third parties on the ground need to be addressed to allow this new industry to operate within a clear legal framework – where all stakeholders know the risks involved and how and at what cost they can protect themselves. In this context, private international air law instruments could be used, such as the 1999 Convention for the Unification of Certain Rules for International Carriage by Air (Montreal Convention)[21] or the Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface (Rome Convention).[22]

At some point, these flights will evolve into international point-to-point transportation of passengers and cargo via outer space, and therefore harmonization of national law is desirable.[23] Rather than applying different laws and requirements to different methods of suborbital flights, the legal system would be better served by one set of rules at both the national and international level that applies to similar activities even if different technologies are used – just like a turboprop is subject to the same rules as a jet plane.[24] Thus, a dedicated set of *sui generis* rules would best serve legal certainty and transparency.

After some deliberation on the qualification of suborbital flights as aviation or spaceflight, the consequences of applying air or space law and thoughts about the selection of the institution or organization that could be mandated with the regulation and management of suborbital flights are included in this Article. Then to illustrate the issues that will arise if uncertainty persists, this Article focuses on the private law topic of liability and insurance for damage to passengers and to third parties on the ground.

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19 In the United States, see, for example, 14 C.F.R. § 460 (2022); 14 C.F.R. § 205 (2022); *see also Human Spaceflight*, FAA, https://www.faa.gov/space/human_spaceflight/ (May 17, 2022). In the United Kingdom, see, for example, Space Industry Act, (2018) c. 5, i, https://www.legislation.gov.uk/ukpga/2018/5/contents. For an analysis of the UK Act, see Lesley Jane Smith & Ruairidh J.M. Leishman, *Up, up and Away: An Update on the UK's Latest Plans for Space Activities*, 44 Air & Space L. 1, 1–26 (2019).

20 *See* Masson-Zwaan & Freeland, *supra* note 11, at 1602, 1604.

21 *See generally* Convention for the Unification of Certain Rules for International Carriage by Air, May 28, 1999, 2242 U.N.T.S. 309 [hereinafter Montreal Convention].

22 *See generally* Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface, Oct. 7, 1952, 310 U.N.T.S. 181 [hereinafter Rome Convention].

23 *See* FAA, Point-to-Point Commercial Space Transportation in National Aviation System: Final Report 1 (2010), https://www.faa.gov/about/office_org/headquarters_offices/ast/media/point_to_point.pdf.

24 *See*, *e.g.*, 40 C.F.R. pt. 87 (2022).

2 Aviation or Spaceflight?

The first question is whether suborbital flights could fit in the current regimes of international air or space law. Both options are briefly discussed below.

A. Regulating Suborbital Flight as Aviation

It is uncertain whether the definition of aircraft in Annexes 7 and 8 of the Chicago Convention[25] could cover rocket-powered vehicles, as they do not derive support from reactions of the air; at least, they do not for some parts of the flight.[26] Because annexes are updated from time to time, the regime established under the auspices of ICAO could be expanded to cover commercial suborbital flights. After all, suborbital vehicles spend the largest part of their journey in airspace, crossing briefly through outer space.[27] That brief transit through the lowest part of outer space could be considered incidental to the larger part of the activity that takes place in airspace.[28]

Applying air law could have several advantages, including the fact that 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.[29] On the other hand, applying that very detailed body of law to an emerging industry may also cause a showstopper as an incident of over-regulation.[30]

In Europe, an extensive European Union (EU) legal framework regulates public as well as private law aspects of air transport.[31] This framework would likely apply to suborbital flights launched from, or passing through, the airspace of EU States if they were labelled as air transport.[32] Although this would have the benefit of providing a comprehensive legal framework, the downside would be that the industry is stifled by detailed requirements regarding safety, consumer protection, and other aspects.[33]

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25 *See* Annexes Summary, *supra* note 15.

26 *Rocket Propulsion*, NASA, https://www.grc.nasa.gov/www/k-12/airplane/rocket.html.

27 *See* FAA, The U.S. Commercial Suborbital Industry: A Space Renaissance in the Making 2, https://www.faa.gov/about/office_org/headquarters_offices/ast/media/111460.pdf.

28 Armel Kerrest & Lesley Jane Smith, *Commentary on Outer Space Treaty 1967: Article VII*, 1 Cologne Comment. Space L. 126, 140 (2010).

29 *See generally* Montreal Convention, *supra* note 21; Rome Convention, *supra* note 22. For an analysis, see *infra* Part 4.

30 *Cf.* Masson-Zwaan & Freeland, supra note 11, at 1606–07 (weighing different approaches regarding the speed at which outer space is explored and developed).

31 *See* Dimitri de Bournonville & Joanna Langlade, *The Aviation Law Review: European Union*, L. Revs. (Aug. 18, 2021), https://thelawreviews.co.uk/title/the-aviation-law-review-3/european-union, *see also* discussion *infra* Parts 4-5.

32 *See* de Bournonville & Langlade, *supra* note 31.

33 *See* Masson-Zwaan & Freeland, *supra* note 11, at 1602–03.

B. *Regulating Suborbital Flights as Spaceflight*

It is difficult to determine whether suborbital flights can be considered a space activity because the concept of suborbital flights is not defined in the 1967 Outer Space Treaty.[34] The Treaty does not specify which activities are to be considered space activities, but reaching orbit does not appear to be a requirement.[35] None of the UN space treaties contain a definition of spacecraft, but there is one, albeit partial, definition of "space object" in the Liability Convention and the Registration Convention: "The term 'space object' includes component parts of a space object as well as its launch vehicle and parts thereof."[36]

Suborbital flights are usually marketed as spaceflight, and because they aim to touch the edge of space, they could be considered a space activity.[37] Indeed, suborbital vehicles are destined to reach outer space just like any other space launch, except with lesser thrust and at least part of the trajectory does go through outer space.[38] So from a functional point of view, these flights have characteristics of space flights, and space law could apply. From a technical point of view, rocket planes bear many similarities to spacecraft, but do not apply the same aerodynamic principles as aircraft.[39] Space law could thus be applied to suborbital flights, but the regime lacks private law governing the relations between operators and passengers.[40] Space law is based on state responsibility and state-based liability and only allows private activity under the authorization and supervision of an appropriate state, as per Article VI of the Outer Space Treaty.[41] Moreover, application of the Registration Convention is problematic because it restricts its scope of application to "space object[s] launched into earth orbit or beyond,"[42] which suborbital vehicles are not.

34 Outer Space Treaty, *supra* note 13.

35 *See id.*

36 Convention on International Liability for Damage Caused by Space Objects art. I(d), *opened for signature* Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention]; Convention on Registration of Objects Launched into Outer Space art. I(b), *adopted* Nov. 12, 1974, 28 U.S.T. 695, 1023 U.N.T.S. 15 [hereinafter Registration Convention].

37 *See*, e.g., Horack, *supra* note 5, *see also Plane Facts: Rocket Planes*, Plane & Pilot Mag., https://www.planeandpilotmag.com/article/rocket-planes/ (Feb. 25, 2020).

38 *See generally* Plane & Pilot Mag., *supra* note 37.

39 *See Rocket Aerodynamics*, NASA, https://www.grc.nasa.gov/www/k-12/rocket/rktaero.html.

40 *See* Outer Space Treaty, *supra* note 13.

41 *Id*. art. VI.

42 *See* Registration Convention, *supra* note 36, art. V.

At the European level, contrary to air transport, there is no body of EU law applicable to commercial spaceflight.[43] The EU's mandate in the field of space is covered in Article 189 of the Treaty on the Functioning of the European Union (TFEU) and excludes harmonization of national space laws.[44]

C. *Conclusion*

Thus, there is no clear conclusion on the suitability of air or space law to regulate suborbital flights. Both regimes present benefits and issues. Air law is likely most suitable as it has an elaborate system of private law,[45] which is lacking in space law. But a full-blown application of air law could have a stifling effect on the industry and would need adjustments, as pointed out in Part VII.

3 Institutional Aspects

Besides questioning what field of law should apply in terms of substantive law, another issue remains regarding what international body would be best suited to oversee the regulatory aspects of suborbital flights in terms of safety, navigation, and other public law aspects, and whether this oversight could fall within international body's mandate. The International Civil Aviation Organization (ICAO) and the UN Committee on the Peaceful Uses of Outer Space (COPUOS) will be addressed below.

A. *A Role for ICAO?*

ICAO is equipped with a comprehensive and tested treaty system contained in the Chicago Convention, and it is complemented by annexes containing Standards and Recommended Practices (SARPs) for all aspects of international civil aviation.[46] These annexes could probably also accommodate suborbital flights in a meaningful and efficient manner. In 2000, the President of the ICAO Council stated:

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43 *See* Tanja Masson-Zwaan, *Liability and Insurance for Suborbital Flights*, Proc. 5th IAASS Conf. §§ 3, 4.2. (2012), https://scholarlypublications.universiteitleiden.nl/access/item%3A2918293/view.

44 Consolidated Version of the Treaty on the Functioning of the European Union art. 189, Oct. 26, 2012, 2012 O.J. (C 326) 131–32 [hereinafter TFEU]; *see also* Tanja Masson-Zwaan, *Regulation of Sub-Orbital Space Tourism in Europe: A Role for EU/EASA?*, 35 Air & Space L. 263, 266–67 (2010); Masson-Zwaan & Freeland, *supra* note 11, at 1601.

45 *See infra* Part 4.

46 *See* Chicago Convention, *supra* note 15. The Chicago Convention has 193 Member States. *The History of ICAO and the Chicago Convention*, ICAO, https://www.icao.int/about-icao/history/pages/default.aspx.

> The idea of adopting ICAO as a model, or expanding the mandate of ICAO to encompass outer space, has been raised before. This approach has merit. SARPs have proven effective in adapting to the dramatic transformation of civil aviation during the past 50 years or so. A global forum of nations is essential for achieving consensus on the management of outer space, and there already exists such a respected and time-honoured structure.[47]

In 2005, the ICAO President suggested that ICAO would be the most appropriate organization to regulate the safety of suborbital flights.[48] That same year, an ICAO Working Paper on the *Concept of Sub-Orbital Flights* stated that, should "foreign airspace(s) be traversed [by suborbital vehicles] and should it be eventually determined that suborbital vehicles [are] subject to international air law, pertinent Annexes to the Chicago Convention would in principle be amenable to their regulation."[49] Neither the 2000 Statement nor the 2005 Working Paper have resulted in any follow-up actions. At the 2010 session of the COPUOS Legal Subcommittee, ICAO concluded that the 2005 document was still valid.[50] So far, ICAO has not taken any further action.[51]

It is not unthinkable that technical rules for suborbital flights could be adopted in the Annexes. After all, ICAO, whose constitution is laid down in the Chicago Convention,[52] was established to keep track with aviation developments through the updating of its Annexes and the establishment of new international arrangements. The aim of the Chicago Convention is to ensure that international civil aviation takes place in a safe and orderly manner,[53] and this Convention grants ICAO the authority to adopt SARPs governing suborbital flights.[54] Also, ICAO possesses rulemaking powers and authority on matters of navigation over the high seas and other oceanic areas where there is freedom of overflight.[55] These areas outside the jurisdiction of states are comparable to outer space.[56]

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47 Tanja Masson-Zwaan & Rafael Moro-Aguilar, *Regulating Private Human Suborbital Flight at the International and European Level: Tendencies and Suggestions*, 92 Acta Astronautica 243, 248 (2013) (quoting *Secure Data Link* Communications, 55 ICAO J. (2000), available at https://www.icao.int/publications/Pages/ICAO-Journal.aspx?year=2000&lang=en).

48 Peter van Fenema, *Sub-orbital Flights and ICAO*, 30 Air & Space L. 396, 396 (2005).

49 ICAO, *Working Paper: Commercial Space Flights*, at Appendix A, para. 6.3, ICAO Doc. LC/36-WP/3-2 C-WP/12436 (May 30, 2005).

50 *See* Comm. on the Peaceful Uses of Outer Space, Rep. on Its Forty-Ninth Session on the Concept of Sub-orbital Flights: Information from the International Civil Aviation Organization (ICAO), Mar. 22, 2010, to Apr. 1, 2010, at para. 2, U.N. Doc. A/AC.105/C.2/2010/CRP.9 (2010), https://www.unoosa.org/pdf/limited/c2/AC105_C2_2010_CRP09E.pdf.

51 *See generally* Masson-Zwaan & Moro-Aguilar, *supra* note 47, at 248–49.

52 Chicago Convention, *supra* note 15, pmbl.

53 *Id*. art. 44.

54 *See* Paul S. Dempsey & Michael C. Mineiro, *ICAO's Legal Authority to Regulate Aerospace Vehicles*, Proc. 3rd IAASS Conf. 6 (2008), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1289547.

55 *See* Chicago Convention, *supra* note 15, art. 12.

56 *See* van Fenema, supra *note* 48, at 401.

In terms of specific proposals to accommodate suborbital flights with the remit of ICAO, the definition of "aircraft" in the Annexes could be amended to include suborbital vehicles, a new Annex on "Space Standards" could be developed, or the Annexes governing navigation and collision avoidance could be amended.[57] ICAO could play a role in the coordination of air and space traffic and could eventually contribute to the definition of the outer limit of airspace.[58]

B. A Role for COPUOS?

So far, COPUOS has not taken a stand about suborbital flights, but there have been proposals to include this topic in its agenda. In 2007, a Working Paper on the "Future [R]ole and [A]ctivities of the Committee on the Peaceful Uses of Outer Space" mentioned a possible role for COPUOS in analyzing and regulating suborbital flights.[59] The impact of suborbital flights on space law was addressed on several occasions by the Legal Subcommittee's agenda item devoted to the definition and delimitation of outer space, and in discussions on the concept of aerospace objects.[60] However, no consensus has emerged,[61] and an agreement on the definition of suborbital vehicles or the legal regime that applies to suborbital flights seems unlikely to occur in the near future. Moreover, COPUOS does not have regulatory powers; so even if it succeeded in reaching a consensus, it likely would not be involved directly in the regulation of suborbital flights.[62]

C. A Joint Role?

In 2015, the two UN bodies in charge of aviation and space activities – ICAO and COPUOS – acting through their Secretariat, the Office for Outer Space Affairs (OOSA), jointly hosted an international meeting in Montreal to

57 Dempsey & Mineiro, *supra* note 54, at 7–8; *see also* Masson-Zwaan & Freeland, *supra* note 11, at 1604.

58 *Cf. Near Space: The Quest for a New Legal Frontier*, Int'l Ass'n for Advancement Space Safety (2020), https://www.mcgill.ca/iasl/files/iasl/near_space_-_the_quest_for_a_new_legal_frontier_0.pdf (noting the lack of any legally defined outer limit to outer space).

59 Comm. On the Peaceful Uses of Outer Space, Rep. on Its Fiftieth Session on the Future Role and Activities of the Committee on the Peaceful Uses of Outer Space, June 6, 2007, to June 15, 2007, at paras. 1, 36–38, U.N. Doc. A/AC.105/L.268 (2007), https://www.unoosa.org/pdf/limited/l/AC105_L268E.pdf.

60 An example is the discussions about the questionnaire on possible legal issues regarding aerospace objects. *See Working Group on the Definition and Delimitation of Outer Space of the Legal Subcommittee*, UNOOSA, https://www.unoosa.org/oosa/en/ourwork/copuos/lsc/ddos/index.html.

61 *See* Roy Balleste, *Worlds Apart: The Legal Challenges of Suborbital Flights in Outer Space*, 49 N.Y.U. J. Int'l L. & Pol. 1033, 1041 (2017).

62 *See Committee on the Peaceful Uses of Outer Space*, UNOOSA, https://www.unoosa.org/oosa/en/ourwork/copuos/index.html.

address some of the issues related to suborbital flights, the groundbreaking "ICAO-UNOOSA AeroSPACE Symposium."[63] The event gathered over 300 participants, mostly from the aviation field.[64]

The aim was to bring together "aviation and space communities from around the globe to explore existing regulations and practices as well as safety management and systems engineering methods with regard to civil aviation, suborbital flights[,] and developments in space transportation."[65] The event further aimed to "[e]xplore challenges and opportunities related to emerging space activities and provide possible ideas on how to address them."[66] Additionally, the event provided insight into the space and civil aviation sectors, including who is doing what, how to get involved, and when and why aviation regulators are involved.[67]

During the symposium, some speakers contended that ICAO could accommodate the regulation of suborbital flights but noted that adaptations may be required.[68] The space characteristics of suborbital flights should not be underestimated, and appropriate consultation and cooperation with COPUOS, the UN body in charge of space activities, remains essential.

A follow-up symposium was hosted by the United Arab Emirates in 2016,[69] and OOSA hosted a third event in 2017 in Vienna.[70] Since then, not much has happened. Perhaps the flights that took place in 2021 could reignite the flame.

At the time of the 2015 symposium, ICAO had also set up a "Space Learning Group" (LG), later joined by OOSA as official co-host of the LG.[71] The LG had no formal status; its main activities were sharing experiences and perspectives, assessing and taking stock, and then preparing

63 Tanja Masson-Zwaan, *UN's Aviation and Space Bodies Meet in Montreal to Discuss Future Activities at the Intersection of Commercial Air and Space Travel*, 40 Air & Space L. 455, 455–56 (2015); *see also UNOOSA AeroSPACE Symposium 2015*, ICAO, https://www.icao.int/meetings/space2015/Pages/default.aspx.

64 *See ICAO SPACE 2015 - LIST OF PARTICIPANTS*, ICAO, https://www.icao.int/Meetings/SPACE2015/Documents/SPACE%202015_LIST%20OF%20PARTICIPANTS_FINAL2.pdf.

65 Masson-Zwaan, *supra* note 63, at 456 (quoting ICAO, *State Letter*, at para. 1, ICAO Doc. AN1/64-14/86 (Nov. 12, 2014), https://www.icao.int/Meetings/SPACE2015/Documents/SL-ICAO%20%20UNOOSA%20Aerospace%20Symposium_English.pdf).

66 *Id*. at 457 (quoting ICAO, *supra* note 65, at Attach. to State Letter, para. 2).

67 For a list of speakers see *UNOOSA AeroSPACE Symposium: List of Confirmed Moderators and Presenters*, ICAO, https://www.icao.int/Meetings/SPACE2015/Pages/Presenters.aspx; for all presentations see *UNOOSA AeroSPACE Symposium: Presentations*, ICAO, https://www.icao.int/Meetings/SPACE2015/Pages/Presentations.aspx.

68 *See* Masson-Zwaan, *supra* note 63, at 459.

69 For the event page see *UNOOSA AeroSPACE Symposium*, ICAO, https://www.icao.int/meetings/space2016/Pages/default.aspx (Mar. 31, 2016). For the relevant ICAO State Letter see ICAO Secretary-General, *Letter*, ICAO Doc. AN1/64-14/86 (Aug. 11, 2015), https://www.icao.int/Meetings/SPACE2016/Documents/066e.pdf.

70 See *United Nations / Italy Workshop on the Open Universe Initiative*, UNOOSA, https://www.unoosa.org/oosa/en/ourwork/psa/schedule/2017/workshop_italy_openuniverse.html.

71 Masson-Zwaan, *supra* note 63, at 456.

next steps.[72] The LG integrated the aviation and space communities by convening regulators, operators, lawyers, scientists, and industry groups.[73] The members were appointed by Member States of ICAO, COPUOS, or both.[74] To assist the LG, ICAO created a Space Program webpage containing two sections: one listing so-called Space Points of Contact & Knowledge Sharers (SPOCKS) and another assembling documents and other resources searchable by state or subject provided by regulators, industry groups, and others engaged in the sector.[75]

D. What About the EU?

The EU has not formally expressed its position on the issue of suborbital flights.[76] If the EU considered suborbital flights as aviation and suborbital vehicles as aircraft, this would entail the requirement of compliance with the EU air transport regime.[77] In terms of public law, the European Aviation Safety Agency (EASA) could play a role in the safety and certification of suborbital vehicles, if suborbital flights qualify as aviation.[78] Steps have been taken in the past to facilitate this, but the effort has been put on hold.[79]

Alternatively, EU Member States might consider characterizing suborbital flights as a space activity and regulate it under national space legislation. However, currently no space legislation of any EU Member State addresses suborbital flights.[80] Should the EU adopt national space legislation, harmonization would be desirable, but the EU is not required to ensure harmonization of national space laws as per Article 189 of the TFEU.[81] It may be preferable to eventually adopt EU regulation on suborbital flights in Europe.

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72 *Id*.

73 *Id*.

74 The initial group represented "China, Curacao, Finland, France, Italy, Japan, Malaysia, the Netherlands, Russia, Saudi Arabia, Spain, Switzerland," the United Kingdom, and the United States, as well as the following organizations: ICAO, UNOOSA, EuroControl, EASA, the International Association for the Advancement of Space Safety (IAASS), and the International Coordinating Council of Aerospace Industries Associations (ICCAIA). *Id*. The author was a member on behalf of the Netherlands. *See id*. at 456 n.6.

75 *See Space Transportation*, ICAO, https://www4.icao.int/space. However, the group has been dormant since 2019, presumably due to other priorities.

76 *See* Masson-Zwaan, *supra* note 44, at 267.

77 *Id*. at 268.

78 *See id*. at 269–70.

79 Jean-Bruno Marciacq, Yves Morier, Filippo Tomasello, Zsuzsanna Erdelyi & Michael Gerhard, *Accommodating Sub-Orbital Flights into the EASA Regulatory System*, IAASS Conf. (2008), https://www.yumpu.com/en/document/view/11509881/accommodating-sub-orbital-flights-into-the-easa-regulatory-congrex.

80 *See National Space Law*, UNOOSA, https://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/index.html. For a useful overview of national space legislation, see Julie Abou Yehia, *In Need of a European Regulation for Private Human Spaceflight*, 8 ESPI 1, 1–3, https://www.files.ethz.ch/isn/124755/espi-perspectives_8.pdf.

81 *See* TFEU, *supra* note 44, art. 189.

E. Conclusion

Of the global institutions that could play a role in regulating the public law aspects of suborbital flights at the international level, ICAO seems better suited and more flexible than COPUOS, but some form of cooperation between the two organizations would be useful. It is desirable and urgent to revive the LG and continue the collaboration between ICAO and COPUOS as the competent UN bodies for regulating international aviation and space activity.

The competence of the EU to regulate suborbital flight will depend on whether the Member States might grant it the mandate to do so.

4 Liability

With a view towards analyzing private law aspects of suborbital flights, this Part addresses the liability regimes in air and space law for damages caused to persons. In international air law, a distinction is made between second-party liability, also referred to as contractual or passenger liability, and third-party liability, liability for damages caused to innocent bystanders.[82] In international space law, only third-party liability is regulated.[83]

A. Air Carrier Liability

1. Second-Party Liability in International Air Law

A detailed regime of air carrier liability for damages caused to passengers, also known as second-party liability, is laid down in the 1929 Warsaw Convention,[84] its various amendments, and the 1999 Montreal Convention.[85] The regime evolved over time and includes extensive case law.[86]

The treaties apply to international carriage of persons, baggage, or cargo by aircraft for reward, and "international carriage" is defined as

> 'any carriage in which, according to the agreement between the parties, the place of departure and the place of destination, whether or not there be a break in the carriage or a transhipment, are situated either within the territories of two States

82 *See* Masson-Zwaan, *supra* note 43.

83 *See id*.

84 *See* Convention for the Unification of Certain Rules Relating to International Carriage by Air arts. 17–31, Oct. 12, 1929, 49 Stat. 3000, 137 L.N.T.S. 11 [hereinafter Warsaw Convention]. The Warsaw Convention has 152 State Parties. *Contracting Parties to the Convention for the Unification of Certain Rules Relating to International Carriage By Air*, ICAO, https://www.icao.int/secretariat/legal/List%20of%20Parties/WC-HP_EN.pdf.

85 *See* Montreal Convention, *supra* note 21, ch. III. The Montreal Convention has 137 state parties. *Convention for the Unification of Certain Rules for International Carriage by Air*, ICAO, https://www.icao.int/secretariat/legal/list%20of%20parties/mtl99_en.pdf.

86 For an extensive analysis, see Pablo Mendes de Leon, Introduction to Air Law 149, 256–57 (10th ed. 2017).

> Parties, or within the territory of a single State Party if there is an agreed stopping place within the territory of another State, even if that State is not a State Party. Carriage between two points within the territory of a single State Party without an agreed stopping place within the territory of another State is not international carriage for the purposes of this Convention.'[87]

This means that aircraft taking off from the Netherlands, flying over but not stopping in Belgium, and landing in the Netherlands count as domestic flights for the purposes of passenger liability under the 1999 Montreal Convention, and that activity therefore falls under national law.[88]

The nature of liability shifted over time as the aviation industry developed.[89] "In the early days, aviation was considered to be a new industry which necessitated protection of the market entrants, leading to a system of limited liability" as enacted in the Warsaw Convention.[90] The Warsaw Convention was amended variously, inter alia to increase the limits of liability.[91] For the carrier to be liable, there must be an "accident" under Article 17 of the Warsaw Convention.[92] In that case, the carrier must compensate damages resulting from the accident in the event of death, wounding, or any other bodily injury sustained by a passenger while on the aircraft or while embarking or disembarking.[93] The term "bodily injury" has been interpreted by many cases around the world.[94]

Over time, the Warsaw Convention, and its various amendments, could no longer meet the requirements of the new era.[95] The industry matured; airlines began to operate more independently from governments; thus, as a result, the Montreal Convention was adopted in 1999.[96] Its aim was to modernize and consolidate the Warsaw system.[97] It was necessary to

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87 Montreal Convention, *supra* note 21, art. 1.1; *see also* Warsaw Convention, *supra* note 84, art. 1.

88 Note that it would still be considered an international air service under the Chicago Convention as far as public law aspects such as safety or navigation are concerned. See Chicago Convention, supra note 15, arts. 5–6.

89 *See* Masson-Zwaan, *supra* note 43, § 2.

90 *See id*. (alteration in original).

91 *See id*.; Gerald F. Fitzgerald, *The Four Montreal Protocols to Amend the Warsaw Convention Regime Governing International Carriage by Air*, 42 J. Air L. & Com. 273, 278, 280 (1976).

92 Warsaw Convention, *supra* note 84, art. 17.

93 *Id*.

94 *See, e.g.*, Cyril-Igor Grigorieff, The Regime for International Air Carrier Liability: To What Extent Has the Envisaged Uniformity of the 1999 Montreal Convention Been Achieved?, at 84–99 (2021), https://hdl.handle.net/1887/3240115; Nandini Paliwal, *Interpretation of the Term 'Bodily Injury' in International Air Transportation- Whether Recovery for Mental Injury Is Tenable Under the Warsaw System and Montreal Convention?*, EALA 1, 8, https://eala.aero/wp-content/uploads/2017/11/EALA-Paper.pdf (citing Eastern Airlines, Inc. v. Floyd, 499 U.S. 530, 545 (1991)).

95 Masson-Zwaan, *supra* note 43, § 2.2.

96 *Id*.

97 Montreal Convention, *supra* note 21, pmbl.

strike a better balance between the interests of the carriers and those of the passengers.[98] A new two-tiered unlimited liability system was introduced, albeit with certain exceptions, such as contributory negligence or wilful misconduct by the passenger.[99] Liability insurance was made mandatory, and an obligation to make advance payments to victims was included to meet their immediate economic needs.[100]

The development from limited to unlimited liability in aviation could serve as an example for suborbital flights.

2. Third-Party Liability in International Air Law

Third-party liability is liability of the carrier towards persons on the ground and property on the ground, i.e. parties with whom the carrier does not have a contract, as opposed to passengers.[101] This liability is addressed by the 1952 Rome Convention[102] and its 1978 Montreal Protocol.[103] These documents impose liability on the carrier subject to certain limits and proof of fault.[104]

In view of the lack of ratification of these instruments by the major aviation states, and because the limits of liability were considered too low and because of the single forum choice, the relevance of these instruments is limited.[105] "In practice . . . *national* law governs the settlement of third[-] party liability in aviation cases."[106] The 2009 General Risks Convention may remedy this by introducing liability principles similar to those of the 1999 Montreal Convention.[107] But with only very few ratifications so far and the absence of ratification by major aviation states, the 2009 General Risks Convention has not yet entered into force[108] and its impact may remain limited as well.

98 *Id.*
99 *Id.* arts. 20–21.
100 *Id.* arts. 28, 50.
101 *See* Rome Convention, *supra* note 22, arts. 1, 14; Protocol to Amend the Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface, Sept. 23, 1978, ICAO Doc. 9257, at art. 1 [hereinafter Montreal Protocol].
102 Rome Convention, *supra* note 22, arts. 1–14.
103 Montreal Protocol, *supra* note 101.
104 Rome Convention, *supra* note 22; Montreal Protocol, *supra* note 101, art. 1.
105 *See* Allan I. Mendelsohn & Renée Lieux, *The Warsaw Convention Article 28, the Doctrine of Forum Non Conveniens, and the Foreign Plaintiff*, 68 J. Air L. & Com. 75, 83 (2003); Gerd Rinck, *Damage Caused by Foreign Aircraft to Third Parties*, 28 J. Air L. & Com. 405, 406, 409, 411 (1962).
106 Masson-Zwaan, *supra* note 43, § 3.
107 *See* Montreal Convention, *supra* note 21, arts. 20, 22; Convention on Compensation for Damage Caused by Aircraft to Third Parties pmbl., art. 4, May 2, 2009, DCCD Doc. No. 42 [hereinafter General Risks Convention].
108 *See* General Risks Convention, *supra* note 107.

3. Air Carrier Liability in EU Law

Air carrier liability in the EU is drawn up in Council Regulation (EC) No. 2027/97,[109] as amended in 2002 by EU Regulation (EC) No 889/2002,[110] to align the liability regimes of EU airlines with the Montreal Convention,[111] which is now an integral part of the EU legal order.

Moreover, the EU protects passenger rights in Regulation (EC) No. 261/2004.[112] This Regulation has been subject to a myriad of interpretations before courts in the EU.[113]

B. Liability for Space Activities

Liability with respect to space activities is very different from liability in aviation.[114] "The provisions in the [space] treaties only concern third parties, i.e. non-contractual liability only."[115] Second-party liability for damage to passengers or other contractual parties is not regulated by international space law.[116] The lack of a private international law regime governing the relationship between passengers and operators of spacecraft, and in particular a liability regime, is one of the main problems of applying space law to suborbital flights.[117]

Article VII of the Outer Space Treaty provides that launching states are internationally liable for damages caused by their space object or its component parts on Earth, in air, or in space to another state party or its natural or legal persons.[118] The Liability Convention confirms this third-party liability, i.e. the launching state is internationally liable for damage caused to another State Party.[119] The compensable damages are "loss of life, personal injury[,] or other impairment of health; or loss of or damage to

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109 Council Regulation 2027/97 of Oct. 9, 1997, Air Carrier Liability in the Event of Accidents, 1997 O.J. (L 285) 1 (EC).

110 Regulation 889/2002 of May 13, 2002, Amending Council Regulation (EC) No 2027/97 on Air Carrier Liability in the Event of Accidents, 2002 O.J. (L 140) 1, 1, paras. 2–7 (EC).

111 Masson-Zwaan, *supra* note 43. § 2.3.

112 Regulation 261/2004 of Feb. 11, 2004, Establishing Common Rules on Compensation and Assistance to Passengers in the Event of Denied Boarding and of Cancellation or Long Delay of Flights, and Repealing Regulation (EEC) No 295/91, 2004 O.J. (L 46) 1, 1 (EC).

113 *See, e.g.,* Mendes de Leon, *supra* note 86, 264–66.

114 Masson-Zwaan, *supra* note 43, § 4.

115 *Id*.

116 The only indirect reference to passengers is that nationals of the launching state and foreign nationals participating in space activity cannot claim compensation. See Liability Convention, *supra* note 36, art. VII.

117 *See, e.g.*, Jürgen Cloppenburg, *Legal Aspects of Space Tourism*, in Space L.: Current Probs. & Persps. for Future Regul. 191, 193 (Marietta Benkö & Kai-Uwe Schrogl eds., 2005). On liability issues posed by suborbital human flight, see Stephan Hobe, *Legal Aspects of Space Tourism*, 86 Neb. L. Rev. 439, 448–54 (2007); Michael Chatzipanagiotis, *The Impact of Liability Rules on the Development of Private Commercial Human Spaceflight*, Proc. 55th IISL Colloquium L. Outer Space 1, 4, 9–10 (2011).

118 Outer Space Treaty, *supra* note 13, art. VII.

119 *See* Liability Convention *supra* note 36, art. VIII.

[public or private] property."[120] Liability is absolute if compensable damage occurs on the Earth's surface or to an aircraft in flight[121] but is fault-based if it occurs somewhere else.[122] The liability is unlimited, i.e. there is no cap under the treaties; there is no direct liability of private operators for space activities; additionally, private third parties are not entitled to claim on their own – only states can.[123] Contrary to air carrier liability, there is no case law to interpret the treaty provisions.[124]

Although liability under the space treaties is unlimited, national laws usually provide caps or limits to liability insurance, often in combination with insurance as a requirement to obtain a license.[125] This implies that the state will assume any risks beyond those limits, as it is subject to unlimited liability under the treaties.[126] So far, only one national space law addresses suborbital flights carrying passengers, and it imposes only third-party liability on carriers, subjecting passengers to a waiver of second-party liability.[127] EU law is still virtually non-existent in this respect, due to the limited mandate of the Union under the TFEU.[128]

C. *Conclusion*

In terms of both second- and third-party liability in air law, a clear regime of operator liability exists in international, national, and EU law. In space law, the regime is much less developed, only covers third-party liability of states, and does not include passenger liability or direct liability of private operators.

5 Liability Insurance

Just like liability in air law is different from liability in space law, aviation insurance and space insurance are also very different.[129] They will be addressed in the following Sections.

120 *Id*. art. I.
121 *Id*. art. II.
122 *See id*. art. III.
123 *See id*. arts. 8–14.
124 *See* Joel A. Dennerley, St*ate Liability for Space Object Collisions: The Proper Interpretation of "Fault" for the Purposes of International Space Law*, 29 Eur. J. Int'l L. 281, 281–83 (2018).
125 *See* A. Kerrest de Rozavel & F.G. von der Dunk, *Liability and Insurance in the Context of National Authorisation*, 78 Space, Cyber, & Telecomms. L. Program Fac. Publ'ns 1, 3 (2011), https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1077&context=spacelaw.
126 *See id*.
127 *See* 14 C.F.R. § 205.5 (2022*); see generally* FAA, *supra* note 19.
128 *See* Masson-Zwaan, *supra* note 44, at 267.
129 *See* Masson-Zwaan, *supra* note 43, §§ 5–6.

A. Liability Insurance in Air Law

Liability insurance in air law evolved from marine insurance and is a well-developed service industry with experienced brokers, insurers, and reinsurers all over the world.[130]

1. The Market

Aviation insurance, including liability insurance, has a long history and many statistics are available.[131] "Insurance for second[-] or third[-]party liability can be mandatory under treaty law, national law[,] and . . . EU law," as explained in the following three Sections.[132] Air carriers usually buy "insurance for multiple takeoffs and landings over a certain period, e.g. a year of operations."[133] The market is characterized by high demand and supply as well as competitive rates.[134] "Insurers benefit from clear liability rules," which facilitate assessing the risks.[135]

Aviation insurers determine their rates based on several risk rating factors, including the area of operation, the jurisdiction concerned, the type of aircraft involved, the volume of turnover in the company, contractual obligations, claims history, and market conditions.[136] "Insurance is sold to carriers through insurance brokers, and the risk is usually spread throughout the market by reinsurers."[137] "Rates for insurance to protect against claims from passengers (second[-]party liability) depend on the type of aircraft used, the flight duration, [and] applicable liability regime(s)," among other factors.[138] Damages covered may range from delays or lost luggage to fatal injury to passengers to costs for search and rescue.[139] "Insurance for carriers against liability for damage to third parties (innocent bystanders, but also public or private property on the ground) is readily available at reasonable cost terms."[140]

130 *See generally* Margo on Aviation Insurance 4–5, 14–15, 31, 559 (Katherine Posner, Tim Marland & Philip Chrystal eds., 4th ed. 2014) (discussing defining characteristics of aviation insurance); see also Allianz, 100 Years of Aviation Insurance (2015), https://www.agcs.allianz.com/news-and-insights/reports/100-years-of-aviation-insurance.html.

131 See, e.g., Aviation Claims Developments, Allianz (Nov. 2019), https://www.agcs.allianz.com/news-and-insights/expert-risk-articles/aviation-risk-report-2020-claims-developments.html; General Aviation Insurance Market: Pricing and Risk Update - Q1 2021, Marsh, https://www.marsh.com/us/industries/aviation-space/insights/general-aviation-insurance-market-pricing-risk-update-2021-q1.html.

132 Masson-Zwaan, *supra* note 43, § 5.

133 *Id*.

134 *Id*.

135 *Id*.

136 *Id*.

137 *Id*.

138 *Id*. § 5.1.

139 *Id*.

140 *Id*. § 5.2.

2. Second-Party Liability Insurance

The Warsaw Convention does not impose compulsory insurance for air carriers against claims from passengers, but the Montreal Convention does.[141] "The idea behind this was to ensure that claimants were sufficiently protected against bankruptcy of the carrier and similar situations, so that they could enforce the rights afforded to them. Safety considerations were also taken into account."[142] National legislation may also contain insurance provisions regarding second-party liability and is especially relevant for flights that do not qualify as international carriage under the Warsaw and Montreal Conventions.[143]

3. Third-Party Liability Insurance

The 1952 Rome Convention stipulates "that contracting states are entitled to require that the operator of an aircraft registered in another contracting state is insured against" damage caused to third parties on the ground, and contains "substantive provisions as to the insurance policy itself."[144] States may impose insurance conditions on foreign airlines in bilateral air services agreements.[145] As seen earlier, national legislation often applies to third-party liability and may also contain insurance provisions regarding third-party liability.[146]

4. Air Carrier Liability Insurance in EU Law

As indicated in Section 4.A.3, several EU instruments address second- and third-party liability of air carriers, and they also include provisions on liability insurance. Regulation 1008/2008 provides that air carriers must comply with the insurance requirements specified in Regulation (EC) No.

141 Montreal Convention, *supra* note 21, art. 50. The Montreal Convention provides: "States Parties shall require their carriers to maintain adequate insurance covering their liability under this Convention. A carrier may be required by the State Party into which it operates to furnish evidence that it maintains adequate insurance covering its liability under this Convention." *Id*. Compare with Warsaw Convention, *supra* note 84.

142 Masson-Zwaan, *supra* note 43, § 5.1.

143 *See supra* Part 4. Some examples are the United States' Aircraft Accident Liability Insurance Rules, 14 C.F.R. § 205 (2022), and the United Kingdom's Civil Aviation (Insurance) Regulations 2005, SI 2005/1089. EU Member States refer to EU law in their national law, *e.g.*, The Netherlands, Wet Luchtvaart 18 juni 1992, Stb. 1992, 368, Titel 7.4.

144 Masson-Zwaan, *supra* note 43, § 5.2 (citing Rome Convention, *supra* note 22, art. 15). The Rome Convention provides: Any Contracting State may require that the operator of an aircraft registered in another Contracting State shall be insured in respect of his liability for damage sustained in its territory for which a right to compensation exists under Article 1 by means of insurance up to the limits applicable according to the provisions of Article 11. Rome Convention, *supra* note 22, art. 15.1.

145 Masson-Zwaan, *supra* note 43, § 5.2.

146 *See supra* Part 4; *see also supra* sources cited note 143.

785/2004.[147] The latter Regulation specifies that air carriers must be insured to cover liability in case of accidents with respect to passengers, luggage, cargo, mail, and third parties, and it defines the amounts of insurance needed.[148] As a result of the 1999 Montreal Convention for the EU coming into force in 2004, the minimum insurance requirements were adjusted to increase, if not do away with entirely, the limits of liability.[149] The most recent requirements are contained in Commission Delegated Regulation (EU) 2020/1118.[150]

B. Liability Insurance in Space Law

Contrary to aviation insurance, the field of space insurance is much less developed. Just like aviation insurance evolved from marine insurance, space insurance was first placed by the aviation market and then developed into an independent insurance branch.[151] Aviation and space insurance remain closely related though, and both products are often offered by the same brokers and insurers.[152]

1. The Market

The insurance industry began providing services to space operators in the mid-1960s. At that time these risks were still covered by the traditional aviation market.[153] The space insurance sector has fewer customers and fewer statistics than aviation insurance.[154] Space insurance must be obtained for each launch, not for several launches over a certain time.[155] Moreover, the severity as well as the frequency of losses is high, putting space activities often at the far right of the risk map.[156] This, in turn, leads to high and volatile insurance rates that react significantly to major losses.[157] Lastly, there is not much certainty about the extent of liability "due to the vague rules and [the] absence of court interpretations."[158] In short, the space insurance

147 Regulation 1008/2008 of Sept. 24, 2008, Common Rules for the Operation of Air Services in the Community (Recast), pmbl., art. 4(h), 2008 O.J. (L 293) 3, 6 (EC).
148 Regulation 785/2004 of Apr. 21, 2004, Insurance Requirements for Air Carriers and Aircraft Operators, 2004 O.J. (L 138) pmbl., arts. 4–7 (EC).
149 *See* Masson-Zwaan, *supra* note 43, § 2.2.
150 Commission Delegated Regulation 2020/1118 of Apr. 27, 2020, Amending Regulation (EC) 785/2004 of the European Parliament and of the Council on Insurance Requirements for Air Carriers and Aircraft Operators, pmbl., art. 1, 2020 O.J. (L 243) 2 (EU).
151 *See generally* Masson-Zwaan, *supra* note 43, § 6.
152 *See* Andrea J. Harrington, Space Insurance and the Law: Maximizing Private Activities in Outer Space 1–14, 102–16 (2021).
153 Masson-Zwaan, *supra* note 43, § 6.
154 *Id*.
155 *Id*.
156 *Id*.
157 *Id*.
158 *Id*.

market has "some unique features" – such as a limited number of clients, the high premiums, a high severity of risks, the uncertain legal environment, and the lack of statistics – that influence rates.[159]

2. Second-Party Liability Insurance

Second-party or contractual liability insurance for damage caused by one space object to another could be purchased on a voluntary basis among contractual partners, but second-party insurance for contractual liability for operators of spaceflights does not yet exist because there have not been any "'passengers' with a contractual link to the operators up [until] now" and because of "the absence of space passenger liability rules."[160]

3. Third-Party Liability Insurance

Third-party liability insurance does exist, but so far it is mainly for damage caused to property.[161] Third-party liability insurance covers damage claims by third parties brought against the launching state, which flows its liability down to private operators and requires them to buy insurance.[162] Thus, this insurance protects operators against the financial consequences of property damage caused to a third party during the launch, in-orbit, or re-entry phase.[163] Insurance for liability occurring during the launch phase is usually included in the launch-services contract.[164] Insurance for liability occurring during in-orbit operations and the re-entry phase is usually relatively cheap, partly because damage in space is subject to fault liability, and in the absence of an agreed standard of fault or caselaw, it may be difficult to prove fault.[165] Like for second-party liability, because private commercial human spaceflight is still in its infancy, there is no real practice of third-party liability insurance for personal injury so far.[166]

159 *Id*.; *see also* Philippe Montpert, Considerations on Space Liability Insurance (Mar. 22, 2010), https://www.unoosa.org/pdf/pres/lsc2010/symp04.pdf. Insurance brokers publish regular market surveys. *See, e.g., Space Insurance Market: Pricing and Risk Update – Q1 2021*, Marsh, https://www.marsh.com/us/industries/aviation-space/insights/space-insurance-market-pricing-and-risk-update-2021-q1.html.

160 Masson-Zwaan, *supra* note 43, § 6.2.

161 For a good overview see Ilias I. Kuskuvelis, *The Space Risk and Commercial Space Insurance*, 9.2 Space Pol'y 109, 109–120 (1993).

162 Masson-Zwaan, *supra* note 43, § 6.3.

163 *See id*.

164 *See* FAA, Liability Risk-Sharing Regime for U.S. Commercial Space Transportation: Study and Analysis, at 3-26 (Apr. 2022), https://www.faa.gov/about/office_org/headquarters_offices/ast/media/faaliabilityrisksharing4-02.pdf.

165 *See id*. at 9-24, 10-3.

166 *See* Sara M. Langston, *Suborbital Flights: A Comparative Analysis of National and International Law*, 37 J. Space L. 299, 324 (2011), https://airandspacelaw.olemiss.edu/pdfs/jsl-37-2.pdf.

C. Conclusion

As far as air law is concerned, insurance against both second- and third-party liability is usually required under international, national, or EU law.[167] In space law, the topic is not addressed in international or EU law; only third-party liability insurance is usually covered in national law as a requirement to obtain a license, but that law does not include insurance for passenger liability.

6 Liability and Insurance for Suborbital Flight under Current Law

After this overview of liability and insurance in the fields of aviation and space, the present Part focuses on the question of how to address liability and insurance in the context of suborbital flights. As previously discussed, there are no liability or insurance rules specific to suborbital flights, and there is no decision on whether these flights could or should fall under aviation liability and insurance regimes or space liability and insurance regimes.[168] Whereas all options are possible in principle, each also has drawbacks, and no option provides a perfect solution.

A. Liability

Should it be decided that suborbital flight is more akin to aviation, and assuming that providers of suborbital flights can be considered as "carriers" under the 1999 Montreal Convention (which is still an open question), it must be determined whether suborbital flights fall under Article 1 of the Convention and qualify as "international carriage."[169] It could well be that taking off in one state for a suborbital flight, leaving national airspace for a brief passage in outer space, and landing in that same state should not be seen as international carriage, but should be subject to national law for passenger liability purposes.[170] Should suborbital flight become international in the future, with the vehicle landing in another state than the one from where it took off, unlimited liability, as per the 1999 Montreal Convention, could be imposed on carriers for damage caused to passengers.[171]

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167 Masson-Zwaan, *supra* note 43, §§ 2.3, 3.

168 *Supra* Part 5.

169 *See* Montreal Convention, *supra* note 21, art. 1.

170 *See supra* Part 4. However, the operator would need to comply with international law for public law aspects such as safety and navigation.

171 *See* Montreal Convention, *supra* note 21, art. 1. Application of the Warsaw Convention would entail limited liability, but it often does not apply anymore. *See* Masson-Zwaan, *supra* note 43, § 2.1.

As far as third-party liability is concerned, the Rome Convention and the General Risks Convention are of limited relevance, while many national laws, as well as EU law, provide for third-party liability.[172]

Should it be decided that suborbital flight is closer to spaceflight, there is no international law imposing second- or third-party liability on the operator, as only states are liable.[173] While second-party liability does not exist at all in international space law, third-party liability for states does exist.[174] It is often passed on to private operators in national space laws, but these laws mostly apply to satellites and not passenger flights.[175] The only available legal framework that addresses commercial passenger flights is U.S. legislation; it provides for third-party liability but not second-party liability because of the "informed consent" procedure.[176] The United States "light touch" approach for liability means that the requirements imposed on operators are kept to a minimum and mainly serve to safeguard the safety of third parties and public property.[177] Passengers, the "second parties," i.e. those who conclude a contract of carriage with an operator, are asked to provide informed consent.[178] By doing that, they declare that they understand the risks involved with the activity they are about to undertake, accept those risks, and will not hold the carrier or the state liable for any damage that might occur.[179] This amounts to a sort of waiver of liability.[180] It may be questionable whether a full waiver of liability in cases of personal injury or loss of life will be enforceable under U.S. law; other national laws so far do not address private human spaceflight.[181]

In short, if air law applies to suborbital flights taking off and landing in the same state and briefly passing through outer space, second- and third-party liability likely apply under national law and EU law. If space law applies, there is no relevant international law imposing liability on commercial carriers, and the only relevant national law imposes third-party liability but no second-party liability.

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172 *See* 14 C.F.R. § 205 (2022); Regulation 1008/2008 of Sept. 24, 2008, Common Rules for the Operation of Air Services in the Community (Recast), 2008 O.J. (L 293) 3 (EC).

173 *See* Liability Convention, *supra* note 36, art. VIII.

174 *See id.*

175 *See* Masson-Zwaan, *supra* note 43, § 6.3.

176 *See* FAA, *supra* note 19.

177 *See* 14 C.F.R. § 460.53 (2022).

178 *Cf.* FAA, *supra* note 19 (discussing how federal law requires operators to inform crew and passengers on space flights of the risks involved); *see generally* Tracey Knutson, *What is "Informed Consent" for Space-Flight Participants in the Soon-to-Launch Space Tourism Industry?*, 33 J. Space L. 105, 106–08 (2007).

179 *See* Knutson, *supra* note 178, at 106–08.

180 *See id.* at 122.

181 *See id.* at 112. And when they do, it is not certain whether second-party liability insurance will become mandatory or whether states will follow the U.S. example and make travel conditioned on passengers signing informed consent forms. That may not be likely in the EU, considering the analogy of the strict passenger protection rules in air law. Masson-Zwaan, *supra* note 43, § 5.1.

B. Insurance

Should it be decided that suborbital flight is aviation that qualifies as international carriage, insurance to cover second-party liability is mandatory under the Montreal Convention.[182] Even if the flight does not qualify as international carriage, most national laws and EU law will also require second-party liability insurance.[183] As far as third-party liability insurance is concerned, third-party liability insurance is mandatory under the 1952 Rome Convention and the General Risks Convention,[184] but their relevance is limited. However, most national laws as well as EU law require third-party liability insurance as well.[185]

Should it be decided that suborbital flight is spaceflight, there is no international law imposing any mandatory second- or third-party liability insurance on the operator. Under the only available national law in this field so far, i.e. U.S. law, "there is no obligation to insure against liability for damage to or loss of life of passengers."[186] In Europe, "there is no obligation to insure against second[-]party liability" either because national laws so far do not address private human spaceflight.[187] Thus, second-party liability insurance so far is not mandatory if operations are considered a space activity.[188] The problem is that the only example of second-party liability insurance is in the aviation market.[189] If an operator wants to obtain, or becomes obliged to purchase, insurance to cover this risk, "it is likely to be placed in the aviation market."[190] But it is not certain that similar rates and conditions from the aviation industry would apply because "the risk involved may be considered much higher."[191] Insurance for third-party liability is mandatory in most national space laws, but those laws mostly apply to satellites and not passenger flights.[192] Here again, the only available model of national law that applies to passenger flights is U.S. legislation, and it provides for mandatory insurance for third-party liability.[193]

The above means that if air law applies, international law and national law will provide for mandatory second- and third-party liability insurance. If space law applies, there is no relevant international law, and the only available national law requires third-party liability insurance, but does not impose second-party liability insurance.

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182 *See* Montreal Convention, *supra* note 21, arts. 1, 50.
183 *See* Masson-Zwaan, *supra* note 43, § 2.3.
184 Rome Convention, *supra* note 22, art. 15; General Risks Convention, *supra* note 107, art. 9.
185 Masson-Zwaan, *supra* note 43, §§ 2.3, 3.
186 *Id*. § 8.
187 *Id*.
188 *Id*.
189 *Id*.
190 *Id*.
191 *Id*.
192 *See id*. § 6.3.
193 *See id*. § 8.

C. Conclusion

There are substantial differences between the various legal systems in air and space law, and in international, EU, and national law in the fields of liability and insurance for both second- and third-party liability. And applying a single system to suborbital flights may not provide a satisfactory solution. Some recommendations on a way forward will be formulated below in Part VII.

7 Recommendations

In the end, the questions remaining are whether to address liability for suborbital flights according to air or space law, and whether to place insurance on the aviation or the space market. Both regimes have positive and negative aspects.

Air law has a well-developed liability regime, both under international and national law, and is accompanied by an extensive body of caselaw.[194] The benefit of applying aviation liability law would be a high level of legal certainty and an operator-based liability system providing efficient protection for passengers and third parties.[195] However, the drawbacks include the fact that operators would have to comply with numerous rules that could impact the new industry and create financial barriers, among others. Suborbital flight is still in its infancy, and applying the full body of air law may delay growth.

On the other hand, international space law is state-based and does not cover all aspects of safety requirements and liability, leaving aside for the moment security and the protection of the environment. In all these areas, air law offers relatively elaborate provisions.[196] Neither international nor national space law contain rules on carrier liability.

In the long term, developing an international regime of *sui generis* rules on liability and insurance for suborbital flights would be preferable in terms of legal certainty.[197] This regime could be reflected in national law for flights that do not qualify as international carriage. Some effort at harmonization among national laws would be desirable to avoid the risk of fragmentation.

The *sui generis* regime could be based on air law, which is most advanced, but also borrow from space law to take into account the different characteristics of suborbital flights, and the regime could involve both ICAO and COPUOS.[198] This will likely take some time, but the industry

194 *Id*. § 2.
195 *See id*.
196 *See supra* Part 4.
197 *See id*. § 9.
198 *See id*.; Masson-Zwaan, *supra* note 63, at 455.

will also take time to mature.[199] In the immediate future, flights will take place in the domestic context and will be subject to national law. During that time, liability and insurance of suborbital flights will be regulated at the national level as aviation or space activity, or as a combination of both. It is not unlikely that states that have already developed rules for suborbital flights will set the trend for other states and for the international regime.

Regarding second-party liability, the new international regime might initially provide for limited liability and move towards unlimited liability as the industry grows, as has been the case in air transport.

Third-party liability could be regulated internationally or left to national law. Until then, the U.S. "light touch" approach for liability seems best suited.[200] The safety of third parties and public property would be safeguarded, while passengers could be asked to sign an agreement of informed consent.[201] They can opt to purchase personal accident insurance before embarking on a suborbital flight to protect themselves. In fact, one insurance provider designed a personal insurance policy in 2012, but it is not known whether one has been sold yet.[202]

Regarding insurance, the new international regime eventually might provide for mandatory second-party liability insurance, after an initial period of applying the informed consent practice initiated by the United States. When second-party liability insurance becomes mandatory, the insurance market will probably take a pragmatic approach and place it on the aviation market, which has vast experience in this field, with necessary adaptations.

Third-party liability insurance will likely be mandatory from the start, and could be placed on either the space or the aviation insurance market, as both markets have experience and capacity in this field. The main problem for insurers will be the assessment of risks based on statistical market information, which is still unavailable. As one insurance expert said: "The big question for the insurance industry is whether this is more like aviation insurance or more like current space policies."[203] But the expert went on to

199 Masson-Zwaan, *supra* note 43, § 9.

200 *See* 14 C.F.R. § 460.53 (2022).

201 *See* FAA, *supra* note 19.

202 Stephen Gandel, *Spaceflights for Richard Branson and Jeff Bezos Spur a Race for Insurers, Too*, N.Y. Times (July 9, 2021), https://www.nytimes.com/2021/07/09/business/richard-branson-jeff-bezos-spaceflight-insurance.html. Customers of orbital commercial flights, *e.g.*, flights to the International Space Station, are also likely candidates for personal insurance policies; for instance, see the Axiom flight with the first all-commercial crew to visit the International Space Station in April 2022. *The Next Giant Leap for Humanity Starts Here. And Now*, Axiom Space, https://www.axiomspace.com/ax1. It is not publicly known whether they have indeed purchased personal insurance. *See* Milton "Skip" Smith, Op-Ed, *Representing the Private Astronaut Is a New Step for Human Spaceflight – and for Space Lawyers*, SpaceNews (Mar. 1, 2021), https://spacenews.com/op-ed-representing-the-private-astronaut-is-a-new-step-for-human-spaceflight-and-for-space-lawyers/.

203 *See* Gandel, *supra* note 202.

say that "[t]here hasn't been a situation where insurance markets haven't stepped up," and there is now possibly enough data on rocket launches to know how to price these policies.[204] Ultimately, a typical suborbital insurance market will emerge – just as the space insurance market eventually arose alongside the aviation insurance market.

In any case, when suborbital flights are about to evolve into point-to-point transportation from one place on Earth to another via outer space, clear rules on liability as well as tailored insurance options for commercial suborbital flights are essential. The 2021 flights of Virgin Galactic and Blue Origin could have given a push towards some answers, but if anything, they have confirmed that the uncertainty persists.

204 *See id*.

C:

The Legal Framework for Space Activities: The Netherlands

XI Registration of Small Satellites and the Case of The Netherlands*

1 Introduction

The use of small satellites is increasing, their field of application is growing, and the group of actors involved with their construction, launch and use is diversifying. Despite some tendencies to argue that special rules need to be developed for these satellites, the view now seems to be emerging that 'small' satellites should not be treated differently than 'big' ones in terms of regulation. After all, the UN outer space treaties do not distinguish between small or large satellites, they rather speak of 'space objects', without precisely defining them.[1] Neither does it matter for the treaties in which orbits small satellites operate nor whether they are 'manoeuvrable' or not. Yet, small satellites present certain characteristics that may require a closer look before applying all the legal requirements that are usually imposed on larger space objects.[2] Questions about the legal ramifications of small satellites are on the agenda of different forums such as the ITU[3] and the UN, and are discussed at many conferences.

Two events held in March 2014 are at the core of this book; one is a symposium organised by the International Institute of Space Law (IISL) with the European Centre for Space Law (ECSL) for the delegates of the Legal Subcommittee of UNCOPUOS,[4] and the other a conference organised by the University of Vienna. The present chapter, addressing registration of small satellites, is based on a presentation given at the latter.

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* *Small Satellites: Regulatory Challenges and Chances*, I. Marboe (ed.), (Brill Nijhoff, 2016), pp. 174-194.

1 On the issue of the (lack of) definition of 'space objects' in the UN outer space treaties see the chapter by Frans von der Dunk in this book.

2 See e.g. Tanja Masson-Zwaan, 'Cubesat regulation in Europe' in Ruedeger Reinhard and Cem O Asma (eds), *Cubesat Technology and Applications* (VKI Lecture Series 2013) 1-21; Neta Palkovitz and Tanja Masson-Zwaan, 'Orbiting Under the Radar: Nano-satellites, International Obligations and National Space Laws' in *2012 Proceedings of the International Institute of Space Law* (Eleven 2013) 566-78; Neta Palkovitz, 'Space Entrepreneurship and Space Law- Future Challenges and Potential Solutions' in *2013 Proceedings of the International Institute of Space Law* (Eleven 2014) 61-72.

3 See on ITU related issues, Attila Matas and Yvon Henri, 'ITU Radio Regulatory Framework for Small Satellite Design and Operation' in *2010 Proceedings of the International Institute of Space Law* (Eleven 2011) 445-51. See also Sylvia Ospina, 'Revisiting the Registration Convention: A Proposal to Meet the Need to Know "What is Up There"' in *Proceedings of the 43rd Colloquium on the Law of Outer Space* (AIAA 2001) 199-209.

4 See the presentations held at the IISL/ECSL Symposium of 2014 at the website of UNOOSA, http://www.unoosa.org/oosa/en/ourwork/copuos/lsc/2014/symposium.html.

First, an overview of the legal instruments that are relevant in the context of registration of small satellites is given. Then, the implementation of the obligation to register is addressed, both by the UN and at national level. Next, the practice of launching States of small satellites will be addressed, with a specific focus on the Netherlands, as well as the practice of launch service providers in this context. The need for capacity building about the legal aspects of small satellites is emphasised, to ensure greater awareness among non-traditional actors.

2 Relevant Legal Instruments

Several legal instruments have an impact on the matter of registration of satellites, including small satellites. They are the early UN resolutions, several UN space treaties, as well as a few later UN resolutions. In addition, some practical instruments are relevant, such as the UN online index and the registration form made available by the UN Office for Outer Space Affairs (UNOOSA). National space legislation will also be addressed in this section, mainly focusing on the Netherlands.

2.1 Resolution 1721B (XVI) and Resolution 1962

UN General Assembly resolution 1721B (XVI) on International Co-operation in the Peaceful Uses of Outer Space was adopted on 21 December 1961 and is the first document referring to registration of objects launched into outer space.[5] The UN General Assembly 'calls upon States launching objects into orbit or beyond to furnish information promptly to the Committee on the Peaceful Uses of Outer Space, through the Secretary-General, for the registration of launchings', and 'requests the Secretary-General to maintain a public registry of the information furnished in accordance with paragraph 1 above'. In fact this resolution is still used as the legal basis to inform the UN of objects launched into outer space, for instance by States that have not ratified the Registration Convention.[6] The Secretariat of UNOOSA has maintained a registry of launchings since 1962 in accordance with this resolution and information has been issued in UN documents in the A/AC.105/INF series.[7]

5 Text available at http://www.oosa.unvienna.org/pdf/gares/ARES_16_1721E.pdf. A useful online index of all UN General Assembly resolutions relating to outer space is maintained by the UN Office for Outer Space Affairs and can be found at https://www.unoosa.org/oosa/en/ourwork/spacelaw/resolutions.html.

6 See below, section 2.3.3.

7 However, the 'Online Index of Objects Launched into Outer Space' contains information on satellites launched from 1957 onwards, see http://www.oosa.unvienna.org/oosa/en/osoindex.html. Note also that when the Registration Convention entered into force in 1976, another register of launchings was established for information received from parties to that convention.

Another relevant UN resolution from the early days is UN General Assembly resolution 1962 (XVIII). It contains the famous 'Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space' that forms the basis of the Outer Space Treaty adopted a few years later. The resolution was adopted on 13 December 1963.[8] Its Principle 7 reads as follows:

> 'The State on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and any personnel thereon, while in outer space. Ownership of objects launched into outer space, and of their component parts, is not affected by their passage through outer space or by their return to the earth. Such objects or component parts found beyond the limits of the State of registry shall be returned to that State, which shall furnish identifying data upon request prior to return.'

These two instruments set the tone for the principles regarding registration of space objects later embodied in the UN space treaties, notably the Outer Space Treaty and the Registration Convention. They clearly do not make any distinction as to the size of the satellites; they apply to small satellites without exception.

2.2 Outer Space Treaty

The Outer Space Treaty[9] was drafted almost fifty years ago in a field subject to fast and profound technological advances, but its basic provisions are still relevant and are broad enough to address a wide range of space activities.[10] The treaty has 103 parties and 25 signatories as at 1 January 2015. It can be said to have reached the status of customary international law, binding even on States that have not ratified it. Article VIII of the Treaty is the most relevant for registration, and reads as follows:

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

8 Text available at http://www.oosa.unvienna.org/pdf/gares/ARES_18_1962E.pdf.

9 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, done 27 January 1967, entered into force 10 October 1967, 610 UNTS 205, 6 ILM 386 (1967), hereafter Outer Space Treaty. See for an in-depth discussion, Stephan Hobe, Bernhard Schmidt-Tedd and Kai-Uwe Schrogl (eds), *Cologne Commentary on Space Law, Vol I* (Carl Heymanns Verlag 2009).

10 See for an excellent analysis of the treaty, Stephan Hobe, Bernhard Schmidt-Tedd and Kai-Uwe Schrogl (eds), *Cologne Commentary on Space Law, Vol I* (Carl Heymanns Verlag 2009).

> space or on a celestial body or by their return to the Earth. Such objects or component parts found beyond the limits of the State Party to the Treaty on whose registry they are carried shall be returned to that State Party, which shall, upon request, furnish identifying data prior to their return.'

Thus, as under resolution 1962, the State of registry retains jurisdiction and control over an object launched into outer space and ownership of objects launched into outer space and of their component parts is not affected by their presence in outer space or by their return to earth.

The Treaty also contains rules about responsibility and liability in its Articles VI and VII.[11] The provisions on responsibility and liability also have an impact on the registration of small satellites, because the Registration Convention, discussed below, provides that it is one of the launching States that must register the object.

Lastly, Article XI of the Outer Space Treaty is relevant in the context of registration. It states that States should inform the UN, the public and the international scientific community about their space activities to promote international cooperation, and that the UN should disseminate such information. This legal provision is used by the Netherlands to provide information to the UN about space objects, without formal registration as a launching State.

2.3 Registration Convention

The 1975 Registration Convention[12] builds upon Article VIII of the Outer Space Treaty. On 1 January 2015, the Convention had 62 ratifications, 4 signatures and 3 declarations of acceptance by international intergovernmental organisations.[13] The last entrants were EUTELSAT IGO, which joined ESA and EUMETSAT by making a declaration of acceptance in June 2014, and Kuwait and Colombia which ratified the Convention in 2014.

The Preamble confirms the desire to make provision for national registration by launching States of objects launched into outer space, and for the UN to establish and maintain a mandatory central register of objects launched into outer space. A further desire is to provide additional means and procedures for States to assist in the identification of space objects.

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11 See the chapter by Said Mosteshar and Irmgard Marboe and the chapter by Frans von der Dunk in this book.

12 Convention on Registration of Objects Launched into Outer Space, done 14 January 1975, entered into force 15 September 1976, 1023 UNTS 15, 14 ILM 43 (1975), hereafter 'the Registration Convention' or 'the Convention in this section. See for an in-depth discussion, Stephan Hobe, Bernhard Schmidt-Tedd and Kai-Uwe Schrogl (eds), *Cologne Commentary on Space Law, Vol II* (Carl Heymanns Verlag 2013). See also Frans G von der Dunk, 'The Registration Convention: Background and Historical Context' in *Proceedings of the 46th Colloquium on the Law of Outer Space* (AIAA 2004) 450-53; Maureen Williams, 'The Registration Convention Thirty Years On' in *Proceedings of the 49th Colloquium on the Law of Outer Space* (AIAA 2007) 264-69.

13 Pursuant to Article VII of the Registration Convention.

Article I defines the terms 'launching State', 'space object', and 'State of registry'. The term 'launching State' means: (i) A State which launches or procures the launching of a space object; (ii) A State from whose territory or facility a space object is launched. The term 'space object' includes component parts of a space object as well as its launch vehicle and parts thereof; and the 'State of registry' is defined as a launching State on whose registry a space object is carried in accordance with Article II.

The definition of the term 'launching State' is particularly important with respect to small satellites and their registration, because these satellites will often be operated by a private entity and launched from abroad, and the question will be whether the State where the private operator is located will consider itself as a launching State, for instance as a State 'procuring' the launch. If this is not the case, that State will not have a basis to register the satellite under the Convention, and unless another launching State registers the satellite, it may remain unregistered.

The use of the word 'shall' in Article II implies an obligation; national registration, the setting up of a national registry and informing the UN Secretary-General of the establishment of that national registry are compulsory. Article III in turn obliges the UN Secretary-General to maintain a register that is fully and openly accessible. Likewise, Article IV uses the word 'shall' in obliging the State of registry to furnish certain information to the UN Secretary-General. However, the words 'to the greatest extent feasible and as soon as practicable' weaken that obligation.

The following information concerning each space object that is launched into earth orbit or beyond must be provided:

- Name of launching State(s);
- An appropriate designator of the space object or its registration number;
- Date and territory or location of launch;
- Basic orbital parameters, including:
- Nodal period (the time between two successive northbound crossings of the equator – usually in minutes);
- Inclination (inclination of the orbit – polar orbit is 90 degrees and equatorial orbit is 0 degrees);
- Apogee (highest altitude above the Earth's surface; in kilometres);
- Perigee (lowest altitude above the Earth's surface; in kilometres);
- General function of the space object.[14]

The information to be provided is vague and general, and, although useful for identifying the launch of a space object, has limited operational value in determining the position of the space object once initial injection into orbit has been performed.

14 Article IV of the Registration Convention. The explanations of the terms 'nodal period', 'inclination', 'apogee' and 'perigee' are not in the treaty but are provided on the UNOOSA webpage.

Additional information may be provided from time to time, and, again 'to the greatest extent feasible and as soon as practicable', States shall notify the UN of objects that are no longer in orbit.

Under Article VI, a State that suffered damage by an object it has not been able to identify, or which may be of a hazardous nature, may request assistance from other States, especially those that have space monitoring and tracking facilities, to identify the object, in accordance with an agreement between the parties concerned and on equitable and reasonable conditions.

Registration *per se* does not have any consequences for the determination of liability for damage caused by a space object. The 'registration State' and the 'launching State' are not necessarily one and the same. Firstly, the definition of 'launching State' can refer to various different States, such as the State that launches, the State that procures the launch, or the State whose territory or facility is used. Secondly, in case of a joint launch, all 'launching States' shall jointly determine which one of them shall register the object. If damage occurs, the registration State will be the most easily identifiable launching State, but all States that qualify as launching State and all parties to a joint launch are jointly and severally liable. The State that paid compensation can present a claim for indemnification to the other launching States.

Information received in accordance with the Convention has been issued in UN documents in the 'ST/SG/SER.E' series. As indicated, the 'A/AC.105/INF' series contains information provided by States who are not party to the Convention and who notify the UN on another basis, e.g. on the basis of resolution 1721B (XVI). The UNOOSA website states that 'approximately 93% of all functional space objects (satellites, probes/landers, manned spacecraft, space station components, etc.) have been registered with the Secretary-General'.[15]

Unfortunately, not all States provide the information they are required to under the Convention, and sometimes, differing information is submitted by different parties. The vagueness of the information to be furnished does not help. It is also confusing that States register objects under different legal instruments – sometimes under the Registration Convention, sometimes under resolution 1721B (XVI), and sometimes on the basis of Article XI Outer Space Treaty. It also happens that several States register the same object, or, worse, that no State does. This is caused by the fact that several States can qualify as a launching State, and thus have a legal basis to register. If they do not agree among themselves which of them will register the object, confusion may arise. Furthermore, the Convention seems to apply only with regard to objects that actually reach orbit, but not to objects whose launch failed. Issues of change of ownership are also not covered, and it seems that the initial State of registry will always retain jurisdiction

15 See http://www.oosa.unvienna.org/oosa/en/SORegister/index.html.

and control, even if the satellite is sold to a private entity in another State, making the exercise of jurisdiction and control quite difficult.[16]

Of course, none of these problems are specific to small satellites, but they do have an impact also in that field. To remedy some of these problems, UN resolution 62/101 was adopted in 2007.

2.4 Resolution 62/101

UN resolution 62/101 of 17 December 2007 is titled 'Recommendations on enhancing the practice of States and international intergovernmental organisations in registering space objects'.[17] It contains six paragraphs, five of which are recommendations to States, and one is a three-fold request to UNOOSA. To start with the latter, the Office is requested to make available a model registration form to assist States and organisations in their submission of registration information, to publish contact details of any national focal points on its website, and to establish web links to the registries available on the internet. As regards the recommendations to States, they encompass the following:

The first recommendation addresses adherence to the Convention. States are encouraged to ratify the Registration Convention, and as long as that is not the case, to use resolution 1721B (XVI) to register their space objects. It also encourages international organisations to make declarations of acceptance in accordance with Article VII of the Convention.

The second recommendation addresses harmonisation and recommends that uniformity be strived for in the type of information provided to the UN. Specific examples include the use of COSPAR designators, of coordinated universal time, and of kilometres, minutes and degrees. Also, more information than what is prescribed by the Convention is welcomed, such as geostationary orbit location, if applicable, change of status in operations when the object is no longer functional, approximate date of decay or re-entry, date and physical conditions of moving the object to a disposal orbit, and web links to official information on space objects. Also, States and international organisations are requested to provide the contact details of the focal points for their appropriate registries, if any.

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16 See on these problems, Setsuko Aoki, 'In Search of the Current Legal Status of the Registration of Space Objects' in *2010 Proceedings of the International Institute of Space Law* (Eleven 2011) 245-55; Kay-Uwe Hörl and Julian Hermida, 'Change of Ownership, Change of Registry? Which Objects to Register, What Data to be Furnished, When, and Until When?' in *Proceedings of the 46th Colloquium on the Law of Outer Space* (AIAA 2004) 454-63; Bernhard Schmidt-Tedd and Michael Gerhard, 'How to Adapt the Present Regime for Registration of Space Objects to New Developments in Space Applications?' in *Proceedings of the 48th Colloquium on the Law of Outer Space* (AIAA 2006) 353-63.

17 See on the process leading to this resolution, Marietta Benkö and Kai-Uwe Schrogl, 'The 1998 European Initiative in the UNCOPUOS Legal Subcommittee to Improve the Registration Convention' in *Proceedings of the 41st Colloquium on the Law of Outer Space* (AIAA 1999) 58-64.

The third recommendation is aimed at achieving the most complete registration. It encourages finding a solution for cases where an international organisation has not yet made a declaration of acceptance or where there is no consensus on registration among the members of that organisation. The State from whose territory or facility a space object was launched should, in the absence of prior agreement, contact States or international organisations that could qualify as 'launching States', to jointly determine who should register the object. In case of joint launches, each space object should be registered separately and included in the appropriate registry of the State responsible for the operation of the object under Article VI of the Outer Space Treaty. Lastly, States should encourage launch service providers under their jurisdiction to advise the owner and/or operator of the space object to address the appropriate States on the registration of that space object. It is especially this last part of the third recommendation that has an impact on operators of small satellites; they are increasingly faced with launch service providers claiming proof that the satellite will be registered before agreeing to launch it. This will be illustrated later on.

The fourth recommendation focuses on a change in supervision of an object while in orbit, e.g. by its sale to an operator in another State. In that case, the State of registry, in cooperation with the appropriate State according to Article VI of the Outer Space Treaty, could furnish additional information to the UN such as: date of change in supervision, identification of the new owner or operator, or any change of orbital position or function of the object. If there is no State of registry, the appropriate State according to article VI of the Outer Space Treaty could furnish that information.

The last recommendation is an open request to States and international organisations, to report to the UN any new developments in their registration practice.

2.5 Resolution 68/74

The full title of UN resolution 68/74, adopted on 11 December 2013, is 'Recommendations on national legislation relevant to the peaceful exploration and use of outer space'. It is a very useful addition to the body of UN legal instruments on outer space, and the result of a successful multi-year workplan conducted by the Working Group on National Legislation Relevant to the Peaceful Exploration and Use of Outer Space led by Professor Irmgard Marboe.[18]

The resolution contains eight recommendations to States considering the adoption of national space legislation.[19] The sixth is the most important in the current context as it concerns registration and reads as follows:

18 United Nations Committee on the Peaceful Uses of Outer Space, 'Report of the Working Group on National Legislation Relevant to the Peaceful Exploration and Use of Outer Space on the work conducted under its multi-year workplan' (A/AC.105/C.2/101, 2012).

19 See the discussion of contents and relevance of this resolution in the chapter by Said Mosteshar and Irmgard Marboe in this book.

> 'A national registry of objects launched into outer space should be maintained by an appropriate national authority; operators or owners of space objects for which the State is considered to be the launching State or the State responsible for national activities in outer space under the United Nations treaties on outer space should be requested to submit information to the authority to enable the State on whose registry such objects are carried to submit the relevant information to the Secretary-General of the United Nations in accordance with applicable international instruments, including the Convention on Registration of Objects Launched into Outer Space, and in consideration of General Assembly resolutions 1721B (XVI) of 20 December 1961 and 62/101 of 17 December 2007; the State may also request information on any change in the main characteristics of space objects, in particular when they have become non-functional.'

The relevance of this document for the registration of small satellites is perhaps not different than its relevance in general for all space objects, but what can be said is that the express provisions in this resolution reinforce the importance attached to registration of all space objects, including small satellites.

3 Implementation of the Obligation to Register

After this overview of instruments addressing registration, some of which are legally binding treaties while others are non-legally binding resolutions, this section looks at how this set of rules and regulations is implemented in practice.

3.1 Model Registration Form

As required by UN resolution 62/101, a model registration form in six languages has been made available on the website of UNOOSA.[20] It consists of four parts and reflects information usually provided by States, as well additional information as recommended in resolution 62/101. The four parts are:

- Part A for information provided in conformity with the Registration Convention or resolution 1721B (XVI);
- Part B for additional information relating to a change of status in operations, as recommended in resolution 62/101;
- Part C for information relating to the change of supervision of a space object, as recommended in resolution 62/101; and
- Part D for additional voluntary information.

20 The registration form is available in MS Word and PDF format. See http://www.oosa.unvienna.org/oosa/SORegister/resources.html.

The questions in Part A, i.e. regarding information provided in conformity with resolution 1721B (XVI) and the Registration Convention, are the most extensive. The first question asks whether a new registration or additional information for a previously registered object is submitted. The next question concerns the launching State(s)/organisation. It asks to identify both the State of registry and other launching States. The question about the designator asks for both the COSPAR designator and the national designator or number. Then, the date and territory of the launch should be filled in, followed by the basic orbital parameters as listed in the Registration Convention. Finally, there is a question about change of status, requesting to specify the date of decay, re-entry or deorbit.

In Part B, additional information is requested based on resolution 62/101. Regarding change of *status*, it asks for (1) the date when the object is no longer functional, (2) the date when the object is moved to a disposal orbit and (3) the physical conditions when the object is moved to a disposal orbit, referring to the UN debris mitigation guidelines. Regarding the basic orbital parameters, the planned or actual geostationary position, if applicable, can be filled in. Finally, a website can be entered as additional information.

Part C also concerns resolution 62/101, but focuses on change of *supervision*. It asks for the date of the change and the identity of the new owner or operator. In case of a change in orbital positions, it asks for the old and new positions, and lastly a change in function can be indicated.

Finally, Part D for additional voluntary information asks for the owner or operator of the object, the launch vehicle, the celestial body the object is orbiting, if other than Earth, and any other information the State of registry may wish to provide.

An Annex to the form contains Section A with instructions, and Section B with definitions. The latter is split according to the four parts of the form.

Registration information can only be submitted by the government of a State of registry through the accredited Permanent Mission to the UN or by the headquarters of an international organisation that has declared acceptance of the rights and obligations under the Registration Convention.

3.2 Online Index of Objects Launched into Outer Space

As explained in sections 2.2.1 and 2.2.3, States and international organisations may submit information to the UN on the basis of the Registration Convention or of General Assembly resolution 1721B (XVI).[21] States may also furnish information on the basis of other provisions, such as Article V or XI of the Outer Space Treaty, as seen in section 2.2.2.[22]

21 The former submissions carry the code ST/SG/SER.E (cf. section 2.2.3), while the latter are referenced as A/AC.105/INF (cf. section 2.2.1).

22 These carry the code A/AC.105.

At the time of writing, there are almost fifty States and two international organisations that have provided information regarding objects launched into outer space in accordance with the Registration Convention and/or General Assembly resolution 1721B (XVI).[23] The 'Online Index of Objects Launched into Outer Space' on the website of UNOOSA currently contains 7045 objects, of which about 6500 are registered: some 2200 under A/AC/105/INF (i.e. resolution 1721B (XVI), and 4300 under ST/SG/SER.E (Registration Convention). [24] Thus, approximately 500 objects are not registered.

The Index contains information on satellites launched from 1957 to the present.[25] It uses names and international designators that are in the public domain. Names and international designators not registered with the UN are written in square brackets ([ ]) and highlighted in green.

There is also a *search* function on the website. Basic search fields include:

- The designation of the space object (either the international designator or the name),
- The State or organisation,
- The date of launch,
- The place of the launch (with not only various launch sites in Algeria, Australia, China, French Guiana, India, Iran, Israel, Japan, Kazakhstan, Kenya, North Korea, Russia, the USA and the Reagan test site on the Kwajalein Atoll, but also air-based, sea-based, or submarine-based launches), and
- The launch vehicle (with a long list of about one hundred different launchers, including for instance ten different Ariane launchers).

In addition, for geostationary satellites one can indicate whether the object is in GSO and whether there is a GSO Satellite Functional Status. One can also search on the presence or absence of a nuclear power source. Furthermore, there is a field called 'UN registration', where one can specify whether or not the object is registered, whether it is registered in the A/AC.105/INF on in the ST/SG/SER.E/ series, or unknown. It is also possible to search according to whether the object is presently in space and where it is located (with a list of almost twenty options, such as 'decayed', 'on an

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23 They are: Algeria, Argentina, Australia, Austria, Belarus, Belgium, Bolivia, Brazil, Canada, Chile, China, Czech Republic, Democratic People's Republic of Korea, Denmark, Egypt, France, Germany, Greece, Hungary, India, Israel, Italy, Japan, Kazakhstan, Lithuania, Luxembourg, Malaysia, Mexico, the Netherlands, Nigeria, Norway, Pakistan, Philippines, Poland, Republic of Korea, Russian Federation, Saudi Arabia, South Africa, Spain, Sweden, Thailand, Turkey, Ukraine, United Arab Emirates, UK, USA, Venezuela as well as ESA and EUMETSAT. See http://www.unoosa.org/oosa/en/SORegister/docsstatidx.html. Note that this page also lists Indonesia and Azerbaijan: http://www.unoosa.org/oosa/en/SORegister/index.html.

24 See http://www.oosa.unvienna.org/oosa/en/osoindex.html.

25 However see also http://www.oosa.unvienna.org/oosa/en/SORegister/index.html where the year 1962 is mentioned.

asteroid', 'heliocentric', 'on Venus' and so on). Searches are also possible on the theme 'manned space flight', where a selection of spacecraft types can be ticked (e.g. 'Apollo', 'Soyuz', etc.) as well as a selection of space station types ('ISS' or 'Mir' components, 'Skylab'…). Lastly, it is possible to search for specific GPS/navigation constellations such as GPS or GLONASS, and for search and rescue constellations (COSPAS-SARSAT).

The above shows that the search possibilities for objects registered with the UN are seemingly endless; any combination of search fields can be filled. It seems fair to conclude that since there is no search field according to the size or mass of the object, the question whether an object is small or large does not make any difference.

3.3 Index of Notifications on the Establishment of National Registries

States are obliged to set up a national registry and to inform the UN of their establishment pursuant to Article II of the Registration Convention. Resolution 62/101 requests UNOOSA to establish links on its website to such registries. This is done by means of an online 'Index of Notifications by Member States and Organisations on the Establishment of National Registries of Objects Launched into Outer Space'.[26] All 29 entries carry an ST/SG/SER.E.INF code, numbered ST/SG/SER.E.INF/1-29, meaning they are all based on the Registration Convention.

One example is this *Note verbale* dated 21 January 2014 from the Permanent Mission of Norway to the UN in Vienna, addressed to the Secretary-General:

> 'The Permanent Mission of Norway to the United Nations (Vienna), in accordance with article II of the Convention on Registration of Objects Launched into Outer Space (General Assembly resolution 3235 (XXIX), annex), has the honour to notify the Secretary-General of the United Nations that Norway has established a registry of objects launched into Earth orbit or beyond, which will be maintained by the Norwegian Space Centre in Oslo.'[27]

The Netherlands is quite unique in this context, as it has set up a national register with two sub-registries. First a UN part, to register objects for which the Netherlands is the State of registry in accordance with Article II of the Registration Convention, and secondly a national part, to register objects for which the Netherlands is responsible in accordance with Article VI of the Outer Space Treaty and has jurisdiction and control under Article VIII,

26 See http://www.unoosa.org/oosa/en/spaceobjectregister/national-registries/index.html.

27 See http://www.unoosa.org/pdf/reports/regdocs/SERE_INF_029E.pdf.

but does not consider itself as the launching State.[28] This will be elaborated below.

4 Small Satellites and the Netherlands

Having reviewed international mechanisms relating to registration and some ways and means of their practical implementation, it is interesting to see what has been done at the national level with regard to the registration of satellites, including small satellites. The case of the Netherlands will be used as an example.[29]

4.1 The Situation in General

Most small satellites are registered, but not always by the State concerned. A few examples are given to illustrate this. Austria registered TUGSAT-1 and UniBRITE in May 2013, just three months after the launch, providing extensive information to the UN.[30] Likewise, in June 2014 Belgium registered and provided information about three precursor satellites of the QB50 project,[31] stating: 'Through its support for the QB50 Precursor Flight mission and more generally for the entire project of which that mission is a part, Belgium attained the status of launching State.'[32]

In May 2014, Russia notified that it had launched 23 small satellites on an intercontinental ballistic missile Dnepr on behalf of foreign clients in November 2013. This included satellites for clients in several States. [33] The

28 Note verbale dated 3 June 2009 from the Permanent Mission of the Netherlands to the United Nations (Vienna) addressed to the Secretary-General (ST/SG/SER.E/INF.24) https://cms.unov.org/LLSULinkbase/ContentTree.aspx?nodeID=2324. The national part of the Dutch registry is available here, it contains satellites operated by the only licensed operator under the Dutch act so far, New Skies Satellites BV: http://www.agentschaptelecom.nl/sites/default/files/ruimtevoorwerpen-database-nationaal-deel.pdf. The UN part of the register is available here but is still empty: http://www.agentschaptelecom.nl/sites/default/files/ruimtevoorwerpen-database-vn-deel.pdf.

29 See for an interesting comparison between the laws of three small states (Austria, Belgium and the Netherlands) in respect of regulating small satellites, Irmgard Marboe and Karin Traunmüller, 'Small Satellites and Small States: New Incentives for National Space legislation' (2012) 38 Journal of Space Law 289.

30 Note verbale dated 13 May 2013 from the Permanent Mission of Austria to the United Nations (Vienna) addressed to the Secretary-General (ST/SG/SER.E/676) http://www.unoosa.org/oosa/en/osoindex/data/documents/at/st/stsgser.e676.html. See on the Austrian space legislation, Irmgard Marboe, 'Austrian Federal Law on the Authorisation of Space Activities and the Establishment of a National Registry (Austrian Outer Space Act)' in *2011 Proceedings of the IISL* (Eleven 2012) 530-37.

31 QB50 is an EU-funded project. See https://www.qb50.eu.

32 Note verbale dated 30 June 2014 from the Permanent Mission of Belgium to the United Nations (Vienna) addressed to the Secretary-General (ST/SG/SER.E/721) http://www.unoosa.org/oosa/en/osoindex/data/documents/be/st/stsgser.e721.html.

33 Note verbale dated 8 April 2014 from the Permanent Mission of the Russian Federation to the United Nations (Vienna) addressed to the Secretary-General (ST/SG/SER.E/709) http://www.unoosa.org/oosa/en/osoindex/data/documents/ru/st/stsgser.e709.html.

names of the satellites and their basic function ('technological applications', 'remote sensing', 'astronomy'…) are listed in the document; no further details are given. A check in the UN Online Index based on the names of all these satellites shows that only five States, i.e. Germany, Republic of Korea, Norway, Poland and the UAE, registered the satellites with the UN. The eleven remaining States, i.e., Argentina, Denmark, Ecuador, Italy, Japan, the Netherlands, Singapore, South Africa, Spain, Ukraine and the USA, did not. Therefore, these satellites are listed in green and between brackets, and the remarks say: 'Mentioned by the Russian Federation in ST/SG/SER.E/709'.

This shows that even though the State of the launch provider tends to submit basic information to the UN, the detailed information that is needed is in most cases not available because the States concerned do not register the satellites themselves.

4.2 The Situation in the Netherlands

For the Netherlands, the UN Online Index lists only two objects, both entered 'for the Netherlands', so both not registered with the UN by the Netherlands. The first concerns a very old satellite, ANS-1, whose decay in 1977 was notified to the UN (a link leads to a NASA webpage). The second concerns Delfi-N3XT, launched in November 2013 and reported by Russia in April 2014, as mentioned above.[34]

The reason for this limited number is twofold. Firstly, the Netherlands has currently only satellites in the *national* part of its registry and none in the UN part, and it does not provide information about objects in the national part of the registry to the UN. A second reason lies in the restrictive interpretation of the scope of the Dutch law, which has the result that small satellites launched by Dutch companies cannot be registered in either part of the Dutch registry, i.e., neither the national part nor the UN part. To explain this, the next section will provide some background about the Dutch national space legislation.

4.2.1 The Netherlands National Space Legislation and Registration of Small Satellites

The Netherlands Space Activities Act, henceforth, in this section, 'the Act' or 'the Dutch Act', in force since 1 January 2008, establishes a flexible licensing system for private space operators, including all necessary requirements such as insurance and regulation of liability issues.[35] The Act contains a

34 The other two satellites launched for the Dutch client are actually listed under the UK (i.e., FUNcube and Triton 1); both are not registered with the UN by the UK.

35 Law Incorporating Rules Concerning Space Activities and the Establishment of a Registry of Space Objects, 24 January 2007, 80 *Staatsblad* (2007), Space Activities Act. An English translation is available at http://www.oosa.unvienna.org/oosa/en/SpaceLaw/national/state-index.html.

series of conditions to be complied with by operators, relating to the safety of persons and property, environmental protection, public order and security, and financial security, as well as compliance with international obligations of the State.

As usual in many national space laws, sufficient insurance coverage is a key requirement for granting a license. The amount of the required insurance is what the Minister considers to be the maximum possible cover for the liability arising from the space activities for which a licence is requested, taking into account what can reasonably be covered by insurance. The liability of the license holder is limited to the sum insured. The Act does not apply to activities of Dutch citizens abroad.

The Dutch Act also creates a Registry for space objects. It stipulates that the Dutch State has the right to recover from private operators any compensation paid by the State for damages caused to third parties.

Registration must be carried out by a launching State, but the Netherlands does not consider itself as launching State for satellites launched abroad for Dutch private entities.[36] 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. The small private satellites are not launched by the Netherlands or from Dutch territory or a Dutch facility. This means that all possibilities to designate the Netherlands as a launching State as defined in Article I of the Registration Convention, which has the same wording as the definition provided in Article I of the Liability Convention, are exhausted. The Netherlands, according to this interpretation, is not a launching State and will therefore not register these satellites in accordance with the Convention, so they will not be entered into the 'UN part' of the national registry.

The second sub-register is for objects for which the Netherlands does not consider itself a launching State but does consider itself as the State responsible under Article VI of the Outer Space Treaty, to carry out authorisation and supervision over Dutch space activities and objects. The Netherlands can provide information to the UN about objects entered into this sub-register in accordance with Article XI of the Outer Space Treaty, which does not mention the launching State but refers to States 'conducting activities in outer space'. It provides that States should inform the UN, the public and the international scientific community about their space activities to promote international cooperation, and that the UN should disseminate such information. The use of this legal provision to provide information to the UN about space objects, without formal registration as a launching State

36 For a good overview of the Netherlands position, see Olivier Ribbelink, 'The registration policy of the Netherlands' in Stephan Hobe, Bernhard Schmidt-Tedd and Kai-Uwe Schrogl (eds), *Current issues in the registration of space objects* (Institute of Air and Space Law of the University of Cologne/German Aerospace Center 2005) 53.

is not unique; in the past it was used by the United Kingdom to register satellites on behalf of Inmarsat IGO.[37]

An interesting question for the Netherlands is whether small satellites fall within the scope of the national space legislation. The Dutch Act applies to the 'launch' of objects from the Netherlands or from a Dutch ship or plane, which is not likely to occur in the near future, and to 'flight operation' and 'guidance of space objects in outer space'.[38] This implies that space objects that are launched from abroad and are neither operated or guided from the Netherlands, do not fall under the law, and hence do not require a license. Indeed, so far, small satellites are generally not 'manoeuvrable'. A narrow interpretation of the Dutch Space Activities Act, which defines space activities restrictively as covering only a 'launch' from the Netherlands or a Dutch ship or plane, 'flight operation' and 'guidance of space objects in outer space', would not cover small satellites that are not manoeuvrable. As a consequence, small satellites would not be registered under the Dutch Act. This could be considered as a too restrictive interpretation of the UN space treaties, which do not restrain themselves according to whether objects are manoeuvrable or not, or whether they are large or small.

As this narrow interpretation was upheld by the Dutch authorities in the first years, small non-manoeuvrable satellites of Dutch private entities were not registered nationally or with the UN. They were not entered in the UN part of the national register because the Netherlands did not consider itself the launching State of satellites launched by a private entity – whether they were small or large. They could not be entered into the national part of the register either, because they were not 'launched', 'guided' or 'operated' from the Netherlands.

This situation was expected to change for two reasons. On the one hand, the technological capabilities of small satellites are developing at a very fast pace, and very soon they will be manoeuvrable and thus will be 'guided' and/or 'operated' from the Netherlands. That means they will fall under

37 See Note verbale dated 9 September 2002 from the Permanent Mission of the United Kingdom of Great Britain and Northern Ireland to the United Nations (Vienna) addressed to the Secretary-General (ST/SG/SER.E/417/Rev.1) https://cms.unov.org/LLSULinkbase/ContentTree.aspx?nodeID=3034.

38 The latter two terms are defined as follows in the Explanatory Note: The term '*flight operation*' is understood to mean the navigation, tracking and control of a space object during the flight phase, i.e. the phase between the launch of the space object and the time at which it takes up a position in outer space. Such activities can be performed from facilities, bases, earth stations or other control centres established on Dutch territory. This likewise applies with regard to the *guidance* of space objects in outer space (outer-space activities in the broad sense). This includes all command and control activities in relation to a space object (usually a satellite) – e.g. the execution of major and minor manoeuvres designed to keep a satellite in its position in outer space or to adjust its position/orbit, checking that there is no space debris in the vicinity that might cause problems, and monitoring the fuel level of geostationary satellites, etc., so as to ensure that satellites can be decommissioned when they are no longer in use (by placing them into a 'decommissioning orbit' around 200 km higher than the geostationary orbit).

the definition of space activities and the Netherlands will require them to be licensed to comply with its obligations under Article VI of the Outer Space Treaty, and will register them in the national part of the registry. Registration in the UN part of the national registry is not expected however, so the UN will not be informed pursuant to Article XI of the Outer Space Treaty.

On the other hand, the Dutch government felt the need to pass an administrative measure, clarifying that satellites that are 'unguided' should also fall under the scope of the law and need to apply for a license. Such an administrative measure was signed by the King on 19 January 2015 and entered into force on 1 July 2015.[39] It made the Dutch Space Act explicitly applicable also to unguided satellite missions. By a broader definition of the concepts of 'operation' and 'guidance', non-manoeuvrable small satellites will henceforth fall under the scope of application of the Dutch Space Act.

4.2.2 A Complicating Factor: The Practice of Launch Service Providers

As an interesting effect of resolution 62/101, launch service providers increasingly require their clients, including those wishing to launch small satellites, to submit proof of registration as a condition for launch.

This can be traced back to a specific provision in the resolution, which provides that 'States should encourage launch service providers under their jurisdiction to advise the owner and/or operator of the space object to address the appropriate States on the registration of that space object'.[40] This means that operators of small satellites will ask their government for a declaration that it will register the satellite.

In the case of the Netherlands this also happened, as the launch provider asked the client for such a declaration. This placed the Dutch government in front of a dilemma: on the one hand it could not register the small satellite because it did not fall within the scope of the Dutch Space Act, because there was no launch, guidance or operation, while on the other hand it had a policy to encourage innovation and not to hamper the business of the Dutch company.

This situation was the catalyst for the initiation of the administrative measure of 2015 to apply the Dutch Space Act to small non-manoeuvrable satellites so that registration at least in the national part of the registry becomes possible. The Netherlands can now also duly carry out its duty to authorise and supervise by imposing a license obligation. Before that, an *ad hoc* solution was found: the government provided a letter and imposed an insurance obligation, so that the company could proceed with the launch of its satellites while at the same the government could protect its interests.

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39 See the 'Besluit ongeleide satellieten' in the Dutch Staatsblad of 28 January 2015, https://zoek.officielebekendmakingen.nl/stb-2015-18.html. The term used is 'unguided' satellites, to remain within the terminology of the law; the term 'small' is not used even though that seems to have become the term of art internationally.

40 See above, at section 2.2.4.

It remains to be seen whether launch providers will consider the registration in the national part of the registry, i.e. without notification to the UN, as satisfactory. The downside of this solution is that the satellite will still not be registered internationally, unless another State does, such as the State from whose territory or facility the launch took place.

The Netherlands is not trying to escape its obligations under the treaties, but believes that bilateral agreements should be concluded between States concerned in order to determine which of them should be considered the launching State for which part of a launch operation. This is in accordance with Article V of the 1972 Liability Convention, which provides that 'participants in a joint launching my conclude agreements regarding the apportioning among themselves of the financial obligation in respect of which they are jointly and severally liable'. States were encouraged to make use of this possibility in resolution 59/115 of 10 December 2004 on 'Application of the concept of the 'launching State''.[41] Such an agreement could also settle which State should register the satellite. Discussions are currently underway for the first such agreement. Then there would be registration by the Netherlands in the national part of the register, and registration at the UN by another State; one that qualifies as a launching State.

5 Conclusions

The general legal framework for space activities under public international law as contained in the UN treaties is sufficiently general and flexible to enable and encourage States to carry out space activities in an orderly manner. National legal regimes specify and implement treaty obligations, enabling the private sector to operate in a clear legal framework. The emergence of small satellites poses new challenges to the regulation of space activities, both in terms of understanding and accommodating their characteristics and those of their operators. They are a promising new tool to explore and use space, and will need legal certainty. In principle, whether a satellite is small or large does not matter under current space law. However, some differences can be observed, including a different treatment in terms of licensing as well as registration.

The actors that own and operate small satellites, which bring so many promises of democratising space, are unconventional. They often do not know about space law requirements and issues such as registration, liability, licenses, insurance, etc. Therefore it is essential to build capacity and create awareness. There is a need to inform them, for instance by means of workshops, information notices, websites, and so on. As demonstrated above, the UNOOSA is doing its part in making the information as well as the requirements transparent and easily accessible via its website.

41 See paragraph 2 of the resolution.

The section in resolution 62/101 recommending that States should encourage launch service providers under their jurisdiction to advise the owner and/or operator of the space object to address the appropriate States on the registration of that space object will also help to build capacity among these new actors. For instance, this concretely led to the practice of launch service providers requiring proof of registration from client's governments.

The section in the same resolution requiring the State from whose territory or facility a space object was launched, in the absence of prior agreement, to contact States or international organisations that could qualify as 'launching States' to jointly determine which State or entity should register the space object is equally important.

Finally, the practice, in accordance with Article V of the Liability Convention, to seek bilateral agreements to settle questions of liability and attribution of the status of launching State will also help to ensure that space objects are duly registered in the future.

Although the registration of small satellites poses certain problems, the tools to remedy them are in place. Over time, with experience and practice, it will be possible to ensure compliance with the UN instruments and national legislation while benefiting to the maximum of the new wave in the space age: the revolution brought by small satellites.

XII Small but on the Radar: The Regulatory Evolution of Small Satellites in The Netherlands*

Abstract

In 2012 the authors presented a paper that explained the regulatory situation with respect to nano-satellites, in selected national laws of European States (IAC-12-E7.5.8, 'Orbiting under the Radar: Nano-Satellites, International Obligations and National Space Laws'). The examples showed a practice which excluded nano-satellites activities from the scope of certain national laws, leaving these satellites to orbit 'under the regulatory radar'.

Since then, the nano-satellite market, and more generally the market for small satellites has grown rapidly with hundreds of small satellites already launched, and many planned missions in the near future. Further, more and more entities are aiming to launch small satellite networks or constellations, which indicates that these satellites will be around to stay.

One State that excluded small satellite activities from being licensed under its national space law was the Netherlands. With time, and as small satellite activities became a Dutch reality, the Government had to consider a solution to enable it to authorize and supervise these space activities, in line with Article VI of the Outer Space Treaty.

In this paper the authors, whose background allows them to provide both industry and academic viewpoints, will present the regulatory evolution that started with the mentioned exclusion, progressed towards an ad hoc authorization process in 2013, and finally, resulted in a Decree extending the scope of the Dutch Space Activities Act (2007) to 'unguided satellites' as of 1 July 2015.

The paper will present and analyze the Decree and its Explanatory Note and will discuss its implications for the key stakeholders. It will conclude with some indications regarding the expected consequences of this new regulatory situation.

1 Introduction

In 2012 the authors presented a paper elaborating on the lack of regulatory instruments related to small satellites activities in the Netherlands.[1] Since then, small satellites activities increased in the Netherlands, which gave

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* *Proceedings of the International Institute of Space Law 2015*, P.J. Blount *et al.* (eds.), (Eleven International Publishing, 2016), pp. 601-612 (with Neta Palkovitz).

1 Neta Palkovitz and Tanja Masson-Zwaan, 'Orbiting under the Radar: Nano-Satellites, International Obligations and National Space Laws' in *IISL Proceedings of the 55th Colloquium on the Law of Outer Space* (Eleven International Publishing 2013) 566.

reason for the legislator to seek further regulation of these activities. This paper describes and analyses the regulatory evolution, which took shape in a new regulatory measure.

Both authors were involved in the regulatory process, one representing the industry, and the other advising the Dutch government. Therefore, this paper includes two different and informed perspectives relating to the mentioned developments.

This paper aims to provide information and background about this process to the international community, because other States may face the challenge of a fast-growing private space industry operating in their jurisdiction that must be authorized and supervised in order to comply with the State's obligations under Article VI of the 1967 Outer Space Treaty.[2] Sharing experience and know-how is useful on the one hand to avoid 'reinventing the wheel' at considerable effort and cost, and on the other hand it may help promote harmony in regulation across States. This may help establish legal certainty for 'new space' entrepreneurs, although the authors of course recognise that different circumstances may require different solutions. Likewise, the efforts of UNCOPUOS, which led to the adoption of the 2013 UN resolution on recommendations on national space legislation[3] were inspired by 'the need for consistency and predictability with regard to the authorization and supervision of space activities', while it was also recognized that different approaches may be taken by States in dealing with various aspects of national space activities.

2 Recent Market Developments

In the early years, at the start of the 21st century, small satellites were mostly used by educational institutions such as universities and research centres. The satellites were launched individually, meaning each operator launched mostly one satellite per mission, and the mission itself was not commercial *per se*.[4]

Nowadays, there are several commercial operators that operate a constellation of small satellites, in order to maximize the platform's potential uses.

2 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, done 27 January 1967, entered into force 10 October 1967, 610 UNTS 205, 6 ILM 386 (1967), (hereinafter: Outer Space Treaty).

3 A/RES/68/74 of 11 Dec. 2013, 'Recommendations on national legislation relevant to the peaceful exploration and use of outer space'.

4 Some missions would have a commercial potential such as in the case of technology demonstrations of a certain system, using a small satellite as the platform.

For example, Planet Labs is a U.S. based private company, which provides image data using a constellation of over 100 small satellites.[5] This is the largest satellites imagery constellation ever launched into orbit, and according to its vision, by 2016 the company will have enough small satellites in orbit to cover the entire Earth every day.[6] In this case the use of small satellites technology allows for better imagery coverage of Earth, since the cost per satellite is lower than of traditional satellites.

Another example of the new generation of small satellites commercial uses is OneWeb.[7] This company plans to build and operate a constellation of approximately 700 satellites of less than 200 kg in LEO, to provide global internet broadband service to hundreds of millions of users in remote areas as from 2019. Arianespace and Virgin Galactic have been contracted to launch several satellites, while Airbus Defense and Space will build some of the satellites.[8]

These two examples show that the developments in the small satellites market are twofold, the satellites missions and applications are increasingly more commercial than in past years, and accordingly this implies in many cases that more than one satellite will be used in order to provide a certain service to customers.

3 Small Satellites in the Netherlands

3.1 Small Satellites Activities in the Netherlands

The first Dutch small satellite that was launched to outer space was Delfi-C3, a 3U CubeSat. It was launched in 2008 as part of a student project at the Delft University of Technology, hereinafter referred to as 'TU Delft'.[9] The students who worked on the project founded a private company as a spin-off, ISIS- Innovative Solutions In Space B.V., hereinafter referred to as 'ISIS'. ISIS' small satellite activities are presented below.

5 See https://www.planet.com/data/

6 *Ibid*.

7 http://oneweb.world.

8 See for instance http://spacenews.com/airbus-wins-oneweb-contract/. Interestingly, Oneweb wishes to reassure the public about the company's trustworthiness: 'We intend to be a very good steward of space. Deorbiting the satellites was a big driver in our design considerations. We do not intend to create a lot of junk.', Brian Holz, OneWeb space systems director, *ibid*.

9 http://www.tudelft.nl/en/current/dossiers/archive/delfi-c3/ see also for more details: http://www.delfispace.nl/delfi-c3 and: http://www.lr.tudelft.nl/en/organisation/departments/space-engineering/space-systems-engineering/projects/delfi-c3-project-page/

In 2013 TU Delft launched another 3U CubeSat named Delfi-n3Xt, which was built by a new group of students.[10]

TU Delft plans to launch the DelFFi mission[11], as part of the QB50 mission.[12] This means that the Netherlands will be represented in this international project, which aims to launch about 50 CubeSats, by participating with two 3U CubeSats.

In addition to the Delfi small satellite program, TU Delft participates in the ambitious OLFAR mission, which aims to create a constellation of small satellites in orbit around the Moon for astronomy research.[13] In summary, the TU Delft small satellites missions are educational and scientific.

The second Dutch entity to launch a small satellite is ISIS, a private company specializing in small satellites systems, launches and applications. ISIS' first satellite, a 3U CubeSat named Triton-1, was launched in 2013 together with the Delfi-n3Xt and FUNcube-1. Triton-1 is the first element of a planned small satellite constellation, which will monitor vessels' traffic using AIS technology.[14] This mission aims to demonstrate the mentioned technology, and has a commercial potential.

The third Dutch entity that launched a small satellite is AMSAT-NL, a non-profit organization linked to the international AMSAT network of radio amateurs.[15] It launched FUNcube-1, a 1U CubeSat. The satellite's mission is to 'educate young people about radio, space, physics and electronics'.[16]

Other Dutch Universities and research organizations are taking their first steps in experimenting with small satellites technology, although no firm launches are planned so far. However, this indicates that the volume of small satellites activities in the Netherlands will increase in the years to come.

3.2 Gaps in the Regulatory Framework

The Netherlands Space Activities Act, in force since 1 January 2008, establishes a licensing system for private space operators, including necessary requirements such as insurance and regulation of liability issues.[17] The Dutch Act applies to the 'launch' of objects from the Netherlands or from a Dutch ship or plane, and to 'flight operation' and 'guidance of space objects

10 http://www.delfispace.nl/delfi-n3xt
11 http://www.delfispace.nl/delffi
12 https://www.qb50.eu/
13 http://www.delfispace.nl/advanced-concepts/olfar-mission
14 http://www.isispace.nl/cms/index.php/projects/triton-missions.
15 http://www.amsat-nl.org/
16 http://funcube.org.uk/
17 Law Incorporating Rules Concerning Space Activities and the Establishment of a Registry of Space Objects, 24 January 2007, 80 *Staatsblad* (2007), Space Activities Act. An English translation is available at: http://www.oosa.unvienna.org/oosa/en/SpaceLaw/national/state-index.html.

in outer space'.[18] This implies that space objects that are launched from abroad and are neither operated nor guided from the Netherlands do not fall under the law, and hence do not require a license.

So far, small satellites are generally not 'manoeuvrable'. The narrow interpretation of the Dutch Space Activities Act, defining space activities restrictively as covering only a 'launch' from the Netherlands or a Dutch ship or plane, 'flight operation' and 'guidance of space objects in outer space', did not cover small satellites that are not manoeuvrable. This turned out to be a too restrictive interpretation of the UN space treaties, which do not restrain themselves according to whether objects are manoeuvrable or not, or whether they are large or small.

As this narrow interpretation was upheld by the Dutch authorities in the first years, small non-manoeuvrable satellites of Dutch private entities were not registered, either in the national part of the Dutch registry or in its UN part. They were not registered in the UN part of the national registry because the Netherlands does not consider itself the launching State of satellites launched by a private entity – whether they are small or large, because it holds the view that space activities can only reasonably be regarded as national activities if it is actually possible to exercise jurisdiction and control over them.[19] The satellites could not be entered into the national part of the registry, because they were not 'launched', 'guided' or 'operated' from the Netherlands.[20]

This situation subsequently changed for two reasons. On the one hand, the technological capabilities of small satellites are developing at a very fast pace, and in the future they will be manoeuvrable and thus will be 'guided' and/or 'operated' from the Netherlands. That means they will fall under

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18 The latter two terms are defined as follows in the Explanatory Note: The term '*flight operation*' is understood to mean the navigation, tracking and control of a space object during the flight phase, i.e. the phase between the launch of the space object and the time at which it takes up a position in outer space. Such activities can be performed from facilities, bases, earth stations or other control centres established on Dutch territory. This likewise applies with regard to the *guidance* of space objects in outer space (outer-space activities in the broad sense). This includes all command and control activities in relation to a space object (usually a satellite) – e.g. the execution of major and minor manoeuvres designed to keep a satellite in its position in outer space or to adjust its position/orbit, checking that there is no space debris in the vicinity that might cause problems, and monitoring the fuel level of geostationary satellites, etc., so as to ensure that satellites can be decommissioned when they are no longer in use (by placing them into a 'decommissioning orbit' around 200 km higher than the geostationary orbit).

19 See 'Note Verbale dated 29 July 2003 from the Permanent Mission of the Netherlands to the United Nations (Vienna) addressed to the Secretary-General', A/AC.105/806 of 22 August 2003; available at: http://www.unoosa.org/pdf/reports/ac105/AC105_806E.pdf.

20 See for more details on registration of small satellites, Tanja Masson-Zwaan, 'Registration of small satellites and the case of the Netherlands', to be published in 2016 as part of a book following up on the conference 'Small Satellites: Chances and Challenges', held at the University of Vienna in March 2014, see: http://kalender.univie.ac.at/einzelansicht/?tx_univieevents_pi1%5Bid%5D=9196.

the definition of space activities and the Netherlands will require them to be licensed to comply with its obligations under Article VI of the Outer Space Treaty.

On the other hand, the government decided to prepare an administrative measure, clarifying that in the future, 'unguided' satellites will fall under the scope of the law and need to apply for a license. However, in the interim, some adjustments were made to comply with the requirements of launch providers.

3.3 Ad Hoc Adjustments

As mentioned in the previous section, three Dutch small satellites were launched in November 2013. At the time, the Dutch Space Activities Act did not apply to these satellites, which means that the three operators were not required to apply for a license under the Act.

This situation was somewhat problematic for the following reasons: first, while the domestic Act did not include small satellites activities under its scope, the UN treaties would nonetheless apply since small satellites activities are a 'space activity' in the meaning of Article VI of the Outer Space Treaty, and are 'space objects' in the meaning of Articles VII and VIII and consequently the Liability and Registration Conventions.[21] This means that although the Netherlands did not accept its status as a 'launching State' as mentioned above, it was still internationally responsible for these activities.

Secondly, there was a need to register the satellites at least in a national registry. Small satellites are launched as auxiliary payloads and usually when launched on board of a foreign launch vehicle, the launch service provider will require that the operator will register its satellite in its State of nationality, even if this practice does not necessarily correspond to the concepts in the Liability and Registration Conventions.[22] This meant that in order to execute their launch, the satellites would have to be registered in the Dutch national registry of space objects, even if the Dutch Space Act did not apply.

For these reasons, it was crucial to find a legal arrangement to solve the described discrepancies. As there was not enough time to issue a Decree before the launch, an *ad hoc* solution was found. The three operators

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21 Convention on International Liability for Damage Caused by Space Objects, done 29 March 1972, entered into force 1 September 1972, 961 UNTS 187, 10 ILM 965 (1971), (hereinafter: Liability Convention); Convention on Registration of Objects Launched into Outer Space, done 14 January 1975, entered into force 15 September 1976, 1023 UNTS 15, 14 ILM 43 (1975), (hereinafter: Registration Convention).

22 This is a recommended practice expressed in: A/RES/62/101 of 17 Dec. 2007, 'Recommendations on enhancing the practice of States and international intergovernmental organizations in registering space objects' see recommendation 3*(d)*: 'States should encourage launch service providers under their jurisdiction to advise the owner and/or operator of the space object to address the appropriate States on the registration of that space object;'

obtained a blanket third party liability insurance policy for their small satellites, covering them for €20 million. The Kingdom of the Netherlands was named as an additional insured party.

With the insurance in place, the Dutch Government approved the launch of the three satellites and agreed to enter them into the national part of the registry, once the new Decree, addressed in the next section, would be in force and a license obtained.

4 Regulatory Changes

4.1 The 'Unguided Satellites' Decree

The Decree extending the application of the Space Activities Act to managing unguided satellites, referred to as 'Decree unguided satellites', was signed by the King on 19 January 2015 and entered into force on 1 July 2015.[23] It makes the Dutch Space Act explicitly applicable also to unguided satellite missions. By a broader definition of the concepts of 'operation' and 'guidance', non-manoeuvrable or 'unguided' small satellites henceforth fall under the scope of application of the Dutch Space Act.

The Decree consists of four articles. Article 1 provides that the Space Activities Act also applies to managing an unguided space object in outer space from the Netherlands by means of a communication connection. Article 2 provides that the Decree will not apply for activities that are already taking place and hitherto did not fall under the Act during *three* months after its entry to force. On top of that, it provides that the Decree will not apply for such activities during *nine* months after its entry into force if an application for a license is submitted within three months after entry into force of the Decree. Article 3 gives the short title of the instrument, and Article 4 determines that the Decree enters into force on July 1, 2015.

4.2 The Explanatory Note

A four-page explanatory note is attached to the Decree, the highlights of which are summarized below.

In the first section, the purpose and rationale are explained by referring to the growing importance of 'unguided' satellites, i.e. whose orbital position cannot be influenced after launch, in the Netherlands. The Decree aims to extend the scope of the Space Activities Act to these satellites. ISIS

23 'Besluit ongeleide satellieten', 18 *Staatsblad* (2015), https://zoek.officielebekendmakingen.nl/stb-2015-18.html. The term used is 'unguided' satellites, to remain within the terminology of the law; the term 'small' is not used even though that seems to have become the term of art internationally. The Decree still has to be notified to the UN for inclusion in its National Space Law Collection, http://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/index.html.

is recognised as a prominent market player, and educational activities of TU Delft in developing and building unguided satellites are also acknowledged. The government expects these activities to further increase, and cooperation between companies and research institutions to intensify. The space sector is seen as 'enabler' for other 'top-sectors' identified in the policy of the Ministry of Economic Affairs. The government's space policy 2014-2020 stresses the importance of space to solve social problems, create space infrastructure, and to provide opportunities for Dutch companies and knowledge institutes to export products and services. [24]

The development of unguided space objects was not foreseen in 2007 when the Dutch Act was adopted, although it does provide the general possibility of extending the scope by means of a Decree.[25] Since unguided satellites do not necessarily pose a lower risk than guided satellites, extension was considered necessary; unguided satellites must comply with the same technical requirements as guided ones, and insurance requirements must also apply. The Netherlands bears international responsibility under Article VI of the Outer Space Treaty and must authorise and supervise national activities by non-governmental entities. Since a communication link with these satellites is maintained from Dutch territory, unguided satellites must be authorised and supervised, just like guided satellites.

The next section of the Explanatory Note deals more specifically with unguided satellites. It argues that legal clarity will contribute to a favourable and stable climate for private parties, and will help promote innovation; thus, extending the scope of the Act will provide assurance to stakeholders. No manoeuvres can be performed to keep unguided satellites in their orbital position or to manoeuver them. Their limited communication capabilities imply that the current generation of unguided satellites operates mainly independently. An increase in the number of unguided satellite applications from the Netherlands is expected; currently about ten market players are active in this field. In the short-term, three licence applications are expected, and two more in the medium term.

There is also a section that addresses the regulatory and administrative burden imposed on private entities by the Decree. As explained earlier, unguided satellites must in principle comply with the same requirements as other space objects. The licensing process was standardized by the Dutch Telecom Agency, and the license application form has been updated to accommodate also unguided satellites. The authorization process for unguided satellites contains no additional information requirements, so the administrative burden is kept to a minimum. The following information must be provided when applying for a license:

24 'Nota Ruimtevaartbeleid 2014-2020', in Dutch, see: https://www.rijksoverheid.nl/documenten/beleidsnotas/2014/09/11/samenvatting-nota-over-ruimtevaartbeleid-2014-2020.

25 See Article 2.2.b.

- Information about the space activities;
- Financial and technical data;
- Proof of third party liability insurance;
- A statement by the International Telecommunication Union (ITU) about the use of frequency rights; and
- A statement about expertise and experience with space activities.

The application form must be completed only once, because a license is given for the duration of the activity and does not require a new application for each new satellite. The Explanatory Note states that it is estimated that about four hours are needed to fill out the application form. At an hourly rate for a 'highly skilled knowledge worker' estimated at €60, this means that the administrative burden would be €240.

The Decree also brings substantive obligations for the operation of unguided satellites, viz., the obligation to take out liability insurance. The annual premium for liability insurance of $20 million is estimated at around 0.1% of the coverage, so will cost around $20,000.[26] This, the Explanatory Note states, can be considered as 'operational cost' because the applicants would also purchase such insurance if this was not a condition to obtain a license.

Finally, the Note provides a brief article-by-article explanation. With regard to Article 1, the rationale for the Decree is again explained. Unguided satellites cannot perform manoeuvres to maintain or change their orbital position. As small satellites are mostly launched to LEO, operators of small-unguided satellites do not have to file for orbital slot allocation with the ITU, however, there is a need to coordinate the use of certain radio frequencies, known as filing rights. In order to obtain those rights, the ITU Radio Regulations require that the transmitter of an unguided satellite can be switched on and off via telecommand, to prevent interference or detect and solve other problems. For this purpose it is necessary to establish a communication link, and if that is managed from the Netherlands, the operation of unguided satellites will from now on fall under the scope of the Dutch Space Activities Act.

For Article 2, the rationale for a transition period is explained, as the Act will also apply to unguided satellites that are already in space. Conditions could be imposed on those activities, pursuant to Article 3.3 of the Act. Without transitory provisions, they would become illegal after the entry into force of the Decree because they are not licensed. The first paragraph provides time to prepare and submit an application, while the second paragraph provides additional time for the Telecom Agency to assess the license applications for on-going activities.

Articles 3 and 4, which deal with the short name and entry into force of the Decree, are not addressed in the Explanatory Note.

26 Although the space insurance market is dynamic and thus policy prices may change.

In addition to the Decree, the government also decided to modify the license application form. The form is the same for all applicants, so the modification was not done specifically for 'unguided' satellites; rather, the update was considered necessary to clarify certain requirements, for instance in terms of documents to be submitted at the time of application.[27] The aim of the government is to facilitate the application process, to assist applicants as much as possible in complying with the requirements, and to limit the requirements to what is realistic and manageable.

5 Assessment, Effects and Consequences

5.1 Assessment

The passing of this Decree is a good example of flexible regulation. It shows that regulations can and should be adapted to changing circumstances. Although the operation of small or unguided satellites was not foreseen when the Dutch Act was drafted, subsequent practice has shown the large growth of this activity and expected further development of this market, with important market activity taking place in the Netherlands. In order to comply with its Treaty obligations, it became necessary to expand the scope of the national legal framework. The Act itself provides for the possibility to do this by means of an administrative Decree, which is less cumbersome than amending the Act itself. The Decree is brief and clear in content, and was developed in close consultation with the market players. However, certain critical notes can be made.

Firstly, in practical terms, the statement measuring the time and effort needed to handle a license application in four hours/€240 seems highly unrealistic in practice. Even though the government does its utmost to assist applicants, considerable effort is required to assemble all documents and provide all the required information. The limitation seems to be motivated by a politically driven desire to show restraint in administrative burden, however lacks any realistic justification.

Likewise, the Explanatory Note seems to assume that a third party liability insurance coverage of $20 million will generally be an acceptable level of insurance for the operation of unguided satellites. However, there is no guarantee that the Minister will indeed uphold this assumption, as the Act entitles him to require what he considers to be the maximum possible cover.[28] If the usual coverage imposed on operators of Geostationary satellites, which generally is €60 million, would be required, operators such as

27 The new form (in Dutch) can be found at: http://www.agentschaptelecom.nl/sites/default/files/207_aanvraag_ruimtevaartactiviteiten.pdf. Like the Decree, it has not yet been included in the UN National Space Law Collection.

28 Article 3(4) of the Act.

TU Delft, AMSAT-NL and ISIS would not be able to realise their mission as the insurance cost would simply be too high. The further assumption in the Explanatory Note that third party liability insurance would be purchased even without a legal obligation to do so is, to say the least, doubtful.

There seems to be confusion between third party liability insurance on the one hand, and asset insurance on the other. Operators of small satellites will not be internationally liable in case of damage, as this liability falls upon to States. Therefore is seems unrealistic to argue that they would take insurance to cover such liability of their own will, hence justifying the expenses for such insurance as normal business expenses.

The Decree makes the Dutch Space Act applicable to unguided or small satellites without considering their different characteristics as compared to traditional satellites. This is problematic especially when trying to incorporate space debris mitigation standards[29] since many of them do not apply to small satellites as they are launched into LEO, while others are simply not technically feasible, such as making orbital manoeuvers in order to speed-up the satellites' re-entry process, in line with the '25 year rule'.

Finally, when aiming to accommodate a new space activity, i.e. small satellites, defining the activity by only one technical characteristic may not be future proof. The choice to define these activities by their lack of manoeuvring abilities is sensible for now, however, small satellites are different from other satellites for many other reasons, and once they will be able to perform orbital manoeuvers, they will be treated exactly the same under the Dutch Space Act. This may raise the need to adjust the Act once more.

5.2 Effects and Consequences

Since the Decree went into force on 1 July 2015, license applications for unguided satellites currently being operated were due by 1 October 2015. Three applications were submitted, viz. by ISIS, TU Delft and AMSAT-NL. In order to facilitate the process, the Telecom Agency had put together an information document to assist the applicants as much as possible. The approach of the Agency is to gather as much information as possible, and to clarify as many issues as possible before the actual submission of the application, so that the actual 'audit' can then be carried out smoothly and efficiently and with all required information available. Close and intense interaction with the applicants will be maintained during the coming months, and within six months, i.e. at the latest on 1 March 2016, a decision will be taken on these three applications.

29 See: Inter-Agency Space Debris Coordination Committee, 'IADC Space Debris Mitigation Guidelines' (IADC-02-01, Revision 1, 2007).

6 Conclusions

While Dutch small satellites activities began during 2008, they were properly regulated only in 2015, and the first licenses will be issued in 2016.

The regulatory evolution of small satellites in the Netherlands is generally a positive one, however, it illustrates the legal 'tragedy' expressed in the need to stay on top of technological advancement and new practices in space activities carried out by, not only, but mostly, private companies.

As this problem is a part of the reality of space law, legislators should be in contact with the

industry and academia in order to bridge the regulatory gap effectively. In the case at hand, an open dialog was created between the legislator and the operators, which made the regulative process a better one, and gave those who would be subject to the Decree a deeper understanding of the upcoming change, and reminding all the parties involved that the most important motivation behind this new Decree is- promoting small satellites activities in the Netherlands.

XIII The Space Law Review: The Netherlands*

1 Introduction to the National Legal, Regulatory and Policy Framework

The Netherlands is a party to all five UN space treaties. It ratified the Outer Space Treaty in 1969, and the Rescue and Return Agreement, Liability Convention and Registration Agreement in 1981. The Netherlands is one of the eighteen parties if the Moon Agreement, which it ratified in 1983.

The Netherlands has been a member of UNCOPUOS since 1977 and is a member of several international intergovernmental organisations relevant for space activities, such as the European Space Agency (ESA), the European Union (EU), and the International Telecommunication Union (ITU). It has also ratified the Tampere Convention on the Provision of Telecommunication Resources for Disaster Mitigation and Relief Operations.

The Ministry of Economic Affairs is the governmental authority in charge of space. The Ministry, through its Directorate-General for Enterprise and Innovation, defines the Dutch space policy. A new policy is adopted approximately every three years and describes the priorities of the Netherlands during ESA Ministerial Conferences, in conjunction with national policy and participation in the programs of the EU and the UN.[1] The government set three main goals in the 2019 policy:

- Maximise the social, scientific, and economic relevance of space activity for the Netherlands
- Realise the Dutch contribution to European autonomous and affordable access and use of space
- Retain ESTEC for the Netherlands and connect it to the Dutch space cluster.

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* *The Space Law Review*, 3rd ed., Joanne Wheeler (ed.), The Law Reviews, UK, 2021. https://thelawreviews.co.uk/title/the-space-law-review/netherlands, Reproduced with permission from Law Business Research Ltd.

1 The current policy dates from 2019. See https://www.rijksoverheid.nl/documenten/beleidsnota-s/2019/06/19/bijlage-1-nota-ruimtevaartbeleid-2019 (in Dutch).

The Ministry delegated the implementation of the Space Activities Act to its Radiocommunications Agency (*Agentschap Telecom*).[2] Another Agency of the Ministry that is relevant for setting up space activities from the business perspective is the Netherlands Enterprise Agency (*Rijksdienst voor Ondernemend Nederland*, RVO).[3] The Netherlands Space Office (NSO)[4] provides advice on and implements the space policy of the Netherlands. The NSO reports to a steering group composed of the Ministry of Economic Affairs and Climate Policy, the Ministry of Education, Culture and Science, the Ministry of Infrastructure and Water Management, and the Netherlands Organisation for Scientific Research (NWO). The Minister of Economic Affairs serves as coordinator. The NSO is governed by a Covenant.[5]

The national legal and regulatory framework of the Netherlands consists of the following instruments[6]:

- Rules Concerning Space Activities and the Establishment of a Registry of Space Objects (Space Activities Act 2006, in force since 1 January 2008)
- Decree of 13 November 2007 containing rules with regard to a registry of information concerning space objects (Space Objects Registry Decree)
- Order of the Minister of Economic Affairs of 7 February 2008 containing rules governing licence applications for the performance of space activities and the registration of space objects, as amended in 2010 and 2015 to update the two related forms:
- Form for registration of space objects
- Form for application for/amendment of a license
- Decree of 19 January 2015 expanding the scope of the Space Activities Act to include the control of unguided satellites (Unguided Satellites Decree)

2 Regulation in Practice

The Netherlands Space Activities Act, hereinafter also referred to as 'the Act', in force since 1 January 2008, establishes a flexible licensing system for private space operators, including all necessary requirements such as insurance and regulation of liability issues. The Act contains a series of condi-

2 See for the Ministry, https://www.government.nl/ministries/ministry-of-economic-affairs-and-climate-policy and for the Radiocommunications Agency, https://www.agentschaptelecom.nl/ and https://www.agentschaptelecom.nl/onderwerpen/ruimtevaart (in Dutch). The general site of the Radiocommunications Agency is also available in English at https://www.agentschaptelecom.nl/radiocommunications-agency.

3 See https://english.rvo.nl/, and https://business.gov.nl/regulation/applying-licence-space-activities/.

4 See https://www.spaceoffice.nl/en/.

5 See https://zoek.officielebekendmakingen.nl/stcrt-2008-500.html (in Dutch).

6 Most are available in English at https://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/index.html.

tions to be complied with by operators, relating to the safety of persons and property, environmental protection, public order and security, and financial security, as well as compliance with international obligations of the State.

Since its entry into force, licenses have been granted to New Skies Satellites B.V., ISIS B.V., AMSAT NL, TU Delft and Hiber B.V. The license to NSS was granted for the guidance of geostationary communications satellites; the latter four operators were granted a license for the operation of unguided space objects in low Earth orbit. In addition, in 2020 Hiber B.V. was granted a second license for the operation of guided objects in outer space. Regular supervision audits have been carried out for all licensees.

So far, no licensing fees have been charged to applicants. The Explanatory Memorandum to the Act argues that this was decided in view of the small number of license applications that was expected, and because it was difficult to foresee what the cost would be. It was also announced that this decision would be subject to review when the total number of license applications would exceed twenty.[7]

2.1 Scope

The Act defines 'space activities' as 'the launch, the flight operation or the guidance of space objects in outer space'[8] and applies to space activities that are performed 'in or from within the Netherlands or else on or from a Dutch ship or Dutch aircraft'.[9] The law does not apply to activities of Dutch citizens abroad, nor to space activities that are performed under the responsibility of the government. The term 'launch' does not require any explanation, and the Netherlands will not be launching space objects anytime soon. The terms 'guidance' and 'flight operation' are further elaborated in the Act's Explanatory Memorandum:

> 'The term "flight operation" is understood to mean the navigation, tracking and control of a space object during the flight phase, i.e. the phase between the launch of the space object and the time at which it takes up a position in outer space. Such activities can be performed from facilities, bases, earth stations or other control centres established on Dutch territory.
>
> This likewise applies with regard to the guidance of space objects in outer space, i.e., outer-space activities in the broad sense. This includes all command and control activities in relation to a space object, usually a satellite, e.g. the execution of major and minor manoeuvres designed to keep a satellite in its position in outer space or to adjust its position/orbit, checking that there is no space debris

7 See https://zoek.officielebekendmakingen.nl/kst-30609-3.html (in Dutch), Sec. I.3.2. It seems likely that this number will be reduced in the near future, as by now considerable experience and insight into the actual costs has been gained.

8 Sec. 1.b.

9 Sec. 2.1.

> in the vicinity that might cause problems, and monitoring the fuel level of geostationary satellites, etc., so as to ensure that satellites can be decommissioned when they are no longer in use, by placing them into a "decommissioning orbit" around 200 km higher than the geostationary orbit.'[10]

The Decree of 2015 extended the material scope of the Act to include the control from the Netherlands of unguided space objects in outer space by means of a communications link. Hence, a license is currently required for the following space activities:

- Launching space objects into outer space
- Operating the flight of space objects in outer space
- Guiding space objects in outer space
- Controlling unguided space objects in outer space.

2.2 Procedure and Requirements

To obtain a license, an application must be addressed to the Minister[11] and sent to the Radiocommunications Agency.[12] A decision must be issued within six months.[13] Should this date not be met, then the General Administrative Law Act provides that the applicant must be notified as soon as practicable and that a reasonable time limit be specified within which the decision can be expected. So far, all license applications have been decided within the six-month period.

The licence is issued for the duration of the space activities, which means that an operator who has been granted a license for the operation/guidance of communication satellites in geostationary satellite orbit does not need to apply for a new license for each new communications satellite in GSO.[14] Although new satellites that carry out the same activity and are similar to the ones for which the license was granted do not require a new license, they do need to be notified to the Agency. Licences are not transferable.[15]

The Ministerial Order of 2008 sets out the procedure and specifies the information and documents to be furnished by the applicant and the requirements it must fulfil, which, as the Act provides, can relate for instance to knowledge and experience, or proof of frequency rights.[16]

The 2015 amendment of the 2008 Order lists the information to be submitted in five categories:

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10 Explanatory Memorandum, *supra* n. 7, Sec. I.3.2.
11 Sec. 4.1.
12 Art. 3 of the Order of 2008.
13 Sec. 5.
14 Sec. 3.6
15 Sec. 8.1.
16 Sec. 4.3.

- The fullest possible description of the space activities, including a description of the applicant's knowledge and experience of conducting space activities
- Relevant technical information about the space activity
- Documentary proof of a liability insurance policy
- Financial documents consisting of:
- A financial statement for the past financial year, including the audit opinion (if issued)
- A projected profit and loss account, with explanatory notes
- A liquidity forecast, with explanatory notes
- A risk analysis indicating what management measures have been taken to safeguard the continuity of the space activities
- Documentary evidence of the authorisation to use frequency space.

These five categories are further specified in the application form, which can be completed online:[17]

a) Plans, knowledge, and experience
Applicants must provide a business plan, project plan or other information that specifically relates to the (planned) space activities. This information must also demonstrate that the applicant has knowledge of and experience in performing the space activities for which a license is being requested. If third parties are engaged by the applicant to perform part of the work for the space activities for which a license is requested, the information must also be provided.

b) Aerospace engineering information
Applicants must provide relevant space technology information about the nature of the mission, the degree of guidance/propulsion, design & development, testing, operations, including information on how communication with the satellite system occurs from the Netherlands, expected lifespan and method of decommissioning, as well as a 'space debris mitigation plan', or a summary thereof.

c) Insurance information
Applicants must submit documentary evidence of insurance coverage for liability arising from the launch as well as the subsequent space activity(s), preferably by means of one or more 'Certificate(s) of Insurance' which provides:
- Information about the insurance contract of the applicant or, if this insurance is included in the launch contract, about the insurance contract of the launch company (name of insurer(s), cover, amount of cover, period of coverage, etc.)

17 See https://www.agentschaptelecom.nl/documenten/formulieren/2017/april/4/aanvraag-wijziging-vergunning-ruimtevaartactiviteiten (in Dutch).

– Mention of the Dutch government as 'additional insured'
– Proof that the insurance premium has been paid.

d) Financial information
Applicants must provide the following:
– The annual accounts for the past financial year, including the auditor's report, if available
– A forecast profit & loss account with explanatory notes
– A liquidity forecast with explanatory notes
– A risk analysis indicating which measures (financial, insurance and space technology) have been taken to guarantee the continuity of space activities.

e) Permission to use frequency space
Applicants must provide proof of the orbital position and frequency rights allocated to it, relating to one or more space objects or space activities for which the license is requested, including:
– A supporting document (e.g., a print screen) of frequency registrations in the Master International Frequency Register (MIFR) of the ITU
– The ID number and satellite name under which the satellite network or satellite system is known to the ITU
– Proof (e.g., copy) of any radio amateur license used, if the amateur frequency band is used when sending commands to the space object.

Based on these requirements, a detailed 'Space Activities Information Document' (SAID) is prepared by the license applicant following a 'Document Requirements Description' (DRD) provided by the Agency. The DRD goes into even more details on the various requirements, however these are beyond the scope of this chapter. The content of the DRD is by default confidential, unless otherwise agreed.

The Radiocommunications Agency lists some practical steps on its website which license applicants are advised to follow.[18] They are advised to request a meeting with the Agency well in advance to discuss the purpose of the space activities, frequency rights and orbit positions and to enter into a cooperation agreement (the Agency acts as 'notifying authority' for satellite companies and arranges filing rights). Applicants are furthermore advised to submit their application form and accompanying documents at least 6 months before the start of the space activities.

The Agency will then engage experts to review the application by means of an audit, looking at financing, insurance, and technology of the planned space activities, checking whether the activities are safe, and whether the applicant has sufficient knowledge and experience. Based on the audit report, the Agency will decide whether it will grant a license, the

18 See https://www.agentschaptelecom.nl/onderwerpen/ruimtevaart.

level of insurance, and how it will check compliance; these regular supervision audits are also carried out with the help of external experts.

Supervision audits take place approximately every three years, taking also into account the availability of the license holder, and are based on an updated SAID. A license can be amended, or a new license can be issued, if the information and circumstances change substantially, e.g., the activity changes significantly, the company is restructured, or major growth occurs.

2.3 Conditions

Conditions regarding the safety of persons and goods, the protection of the environment in outer space, financial security, protection of public order, security of the State, or the fulfilment of the international obligations of the State can be attached to the license.[19]

Sufficient insurance coverage is a key requirement for granting a licence. The amount of the required insurance is what the Minister considers to be the maximum possible cover for the liability arising from the space activities for which a licence is requested, taking into account what can reasonably be covered by insurance.[20]

This leaves room for flexibility and has for instance resulted in the determination of a lower amount for in-orbit third-party liability insurance for unguided satellites, as explained in Section III.

2.3.1 Safety and Security

A license can be refused or revoked if the safety of persons and goods, environmental protection in outer space, the maintenance of public order or national security are jeopardized.[21] In case of safety or environmental risk, necessary measures will be taken and the license holder will be instructed to perform accordingly.[22] In case of a safety incident, the license holder must implement all reasonable mitigation and remediation measures to the greatest extent possible and provide all relevant information.[23] So far, no applications have been refused nor has any license been revoked under these provisions.

2.3.2 Registration

In terms of registration requirements, licensees must furnish information required for the space objects registry that the Minister maintains.[24] The

19 Sec. 3.3.
20 Sec. 3.4.
21 Sec. 6.1.b and 7.1.c.
22 Sec. 7.4.
23 Sec. 10.
24 Sec. 11.

Order of 2008 reiterates the obligation to register and refers to a special form to be used. The Decree of 2007 sets out the details for this process.[25] The Netherlands has created a unique format for its national registry in that it consists of a national part and a UN part, flowing from its interpretation of the definition of a launching State. This is further is explained in Section III.

2.3.3 Redress and Liability

The Act stipulates that the State has the right to recover from private operators any compensation paid by the State for damages caused to third parties.[26] The liability of the licence holder is limited to the sum insured.[27]

2.3.4 Enforcement and Penalties

Enforcement and administrative penalties the State can impose are addressed in Chapter 5 of the Act (Sec. 13-26). The provisions set out the procedures and time limits of the various steps involved. The right to impose an administrative penalty ends five years after the infringement is committed, but if an objection is raised or an appeal is brought, the expiry date is deferred until a decision has been made on that objection or appeal.[28]

2.3.5 Compliance with space debris mitigation guidelines, such as in relation to end-of-life

Debris mitigation is not addressed explicitly in the Act or regulations, but in practice, compliance with various international guidelines such as the UNCOPUOS Space Debris Mitigation Guidelines, the IADC Space Debris Mitigation Guidelines, the ITU-R S.1003 Regulations, the ISO Space Debris Mitigation Standards and the EU Code of Conduct for Space Debris is required. The license application form asks for a debris mitigation plan or a summary thereof. The DRD further details the requirements, e.g., regarding measures and methods for debris mitigation and remediation, expected life expectancy of satellites, and plans for decommissioning. Furthermore, it is mandatory to report any anomalies, to calculate collision risks according to existing criteria (e.g., IADC, CSpoC) and adapt missions accordingly when needed.

25 Art. 4, Order of 2008. The current form can be found at https://www.agentschaptelecom.nl/onderwerpen/ruimtevaart/documenten/formulieren/2017/april/4/aanvraag-registratie-ruimtevoorwerpen.

26 Sec. 12.1.

27 Sec. 12.2.

28 Sec. 17.

3 Distinctive Characteristics of the National Framework

3.1 Small Satellites

The definitions of 'operation' and 'guidance' in the Dutch Act effectively excluded nanosatellites from its scope of application, as these satellites can usually not be navigated, manoeuvred, or controlled in the sense of orbit correction.

This situation will change, because the technological capabilities of small satellites are developing at a very fast pace, and soon they will be manoeuvrable and thus will be 'guided' and/or 'operated' from the Netherlands. That means they will fall under the definition of space activities and the Netherlands will require them to be licenced to comply with its obligations under Article VI of the Outer Space Treaty and will register them in the national part of the registry.

Still, the government felt the need to pass an administrative measure, clarifying that satellites that are 'unguided' should also fall under the scope of the law and need to apply for a licence. Such an administrative measure was signed by the King on 19 January 2015 and entered into force on 1 July 2015. It made the Space Activities Act applicable also to unguided satellite missions. By a broader definition of the concepts of 'operation' and 'guidance', non-manoeuvrable small satellites henceforth fall under the scope of application of the Act.

One matter that had to be addressed was the limit of third-party liability insurance that would be required from small satellite operators. The coverage imposed on operators of geostationary satellites in Europe is generally €60 million euros, however this was considered prohibitive for operators of small satellites. The Explanatory Memorandum to the Decree argues that the annual premium for a liability insurance covering up to $20 million in damage caused during in-orbit operations would be affordable for operators of small satellites.[29] This amount has since then been required from small satellite operators, with the understanding that the launch itself would need to be covered separately; launch insurance is usually included with the launch contract, though this would need to be verified during the audit.

3.2 Generic License, so far free of charge

As explained above, a license is granted for an activity, not for a satellite. Regular supervision audits take place and any developments such as deorbiting, new satellites, changes in orbit etc. as well as annual insurance certificates must be communicated to the regulator, but do not require a new license. Until now, licenses are free of charge. This is quite unique, and attractive for operators, especially those who launch and operate multiple satellites.

29 Explanatory Memorandum, Sec. 3. Available in English at https://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/index.html.

3.3 Registration practice

The Netherlands has set up its national registry for objects launched into space, as required by the Registration Convention.[30] However, it has created two separate parts of this national registry: a national part and a UN part. The UN part only contains space objects for which the Netherlands considers itself the 'launching State'. According to the UN space treaties, registration must be carried out by a launching State.

A launching State is defined in the Registration Convention and the Liability Convention as a State which launches or procures the launching of a space object; or a State from whose territory or facility a space object is launched. There is no definition of 'procuring a launch', but many States accept the qualification of 'launching State' when one of their private entities purchases launch services from a foreign launch provider, and consequently they register the space object with the UN as per the Registration Convention.

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.[31] Therefore, the satellites of private operators licensed under the are not entered into the 'UN part' of the national registry, but in the 'national' part, which contains the space objects for which the Netherlands does not consider itself a launching State but does consider itself as the State responsible under Article VI of the Outer Space Treaty, resulting in an obligation to carry out authorization and supervision.

The Netherlands also does not register those satellites with the UN as per the Registration Convention. Rather, but provides information about objects entered into this national part of the register in accordance with Article XI of the Outer Space Treaty, which does not mention the launching State but refers to States 'conducting activities in outer space'. The use of this legal provision to provide information to the UN about space objects, without formal registration as a launching State is not unique; in the past it was used by the United Kingdom to register satellites on behalf of Inmarsat IGO.

30 See https://www.agentschaptelecom.nl/documenten/publicaties/2019/10/31/register-ruimtevoorwerpen.

31 See https://www.isispace.nl/news/brik-ii-first-signals-received/. Brik II will soon become the first object registered in the UN part of the Dutch register and will be notified to the UN under the Registration Convention, as a satellite for which the Netherlands is the launching State.

3.4 Application to future activities

The Act is quite unique in that it explicitly provides for the possibility of broadening its scope of application in the future by an Order in Council to include the organization of space activities by natural or juridical persons from within the Netherlands.[32] The Explanatory Memorandum mentions 'space tourism' as an example[33], however this might equally apply to other future activities such as space resource utilisation.

4 Current Developments

As assessment is currently being carried out about the need to adapt the legal and regulatory framework in view of the adoption of the UNCOPUOS Guidelines on the Long-Term Sustainability of Space Activities of 2019, and more generally the robustness of the framework to address the plans of (future) licensees. The result of this assessment will be used as input for a foreseen amendment of the law, to make it more robust and flexible, so that it is more futureproof. Open norms will be strived for, which will be beneficial for operators. Any amendment or new law must go through the parliamentary process and public consultation via the *Staatscourant* (official Gazette). The process will start with informal one-on-one interviews with the current licensees, after which a draft will follow a public consultation process. It will take several years before a new law is adopted.

It is not unlikely that as part of this review, a decision to charge a fee will be taken, in view of changed circumstances in the space sector. However, this would likely be a one-time fee that is relatively low and serves only as a threshold. The expectation is that the concept of a 'license for the activity, not per satellite' will be maintained, and thus a future fee would also be modest and one-off for the activity. Moreover, the same fee would likely be charged for any kind of license under the Act.

Other topics that could be addressed in the future include space traffic management and space situational awareness.

A new national space policy is expected to be adopted before the next ESA Ministerial Council.

5 Outlook and Conclusions

The current legal and regulatory framework of the Netherlands framework is perceived positively both nationally and internationally. The framework is transparent, fair and reasonable. There is no undue burden on the

32 Sec. 2.2.b.
33 Sec. II, Art. 2.

industry, and requests are received regularly from companies considering establishing their activity in the Netherlands. The Netherlands is generally open to considering such requests, as long as there is a commitment for societal engagement, including employment and sustainability. Companies value the process and the legitimacy and credibility that a Dutch license provides to their activities nationally and internationally. This is reflected also in companies obtaining considerable investments after having been licensed.

A revision of the law can be expected in the coming years, to make the law more robust to the rapidly changing environment. However, the regulatory framework will undoubtedly remain focused on encouraging innovation in the space industry in a safe and secure environment, taking into account the interests of all stakeholders and the society at large.

XIV A View of the Future

The central research question of this study asked whether the existing international legal framework for space activities adequately regulates the current and future challenges and opportunities of the use, exploration and exploitation of outer space, and if not, how this can be remedied. The sub-questions specifically analysed current and future challenges, future opportunities, and the Netherlands' legal framework as a case study.

Reading through the preceding chapters, one could bluntly reply 'no' to those questions; it has become clear that, although a basic legal framework is in place, it cannot address all current and future challenges and opportunities. However, as legal scholars usually do, this short answer would have to be supplemented with the traditional 'but', to read 'no, but'. Indeed, the legal framework that was carefully built during the first sixty years of space exploration is of immense value and must be preserved. *But* it is not sufficiently robust to address all the new questions that are arising because of the rapid pace at which technology advances and of the increase and variety of actors in this field. It is simply not sufficient to govern the continued and expanding use and exploration of outer space in a sustainable, safe and secure manner.

For that reason, both with respect to current and future challenges as well as to embrace future opportunities that the use and exploration of outer space can bring, and to further enhance the efficient and future-proof national implementation of international law, it is necessary to *clarify and supplement* the existing legal framework, in other words, to *widen the horizons of outer space law*. The next sections address (1) what needs to be clarified, (2) what supplements are needed, (3) how clarifying and supplementing space law could be accomplished, (4) what role national law can play in this context, and (5) ends with some final thoughts on the future of space law.

1 Clarifying Space Law

Certain concepts must be clarified to provide legal certainty, such as the exact definition of *space object*, which leaves open the question whether an inactive object such as debris qualifies as such and is subject to the legal consequences of that qualification. Objects that are no longer functional should still fall under the definition of space object, because otherwise they would have an unidentified legal status. The contrary would mean that there would be no liability for the compensation of damages under the 1972

Liability Convention, which stipulates that damage must be 'caused by a space object'.[1] If there is no risk of being held liable for damage caused by a non-functional object, there would be no incentive for States to remove these objects by deorbiting them and requiring private operators under their jurisdiction to do so as part of the licensing conditions. The definition of space object that is contained in the UN space treaties does not exclude such a broad interpretation, as it defines space objects as 'including component parts as well as the launch vehicle and parts thereof' and says nothing about the active or inactive status of space objects.[2]

Likewise, it is necessary to clarify the meaning of *fault* in case of damage occurring in outer space.[3] States as well as insurers and private entities ought to know what constitutes fault, and how they can mitigate or avoid it. Not de-orbiting an object after its useful life could be considered an element of fault, just as de-orbiting it could be seen as a factor mitigating fault. Jurisprudence on this matter would greatly help in clarifying the concept of fault, but it is not likely that a case will be brought before an international court or tribunal in the near future, as States seem to prefer to solve their disputes via other means. Indeed, there has never been an international adjudication involving a dispute between States, neither in the International Court of Justice, nor via the specially developed optional rules for arbitration of disputes relating to outer space related of the Permanent Court of Arbitration.[4]

The concept and scope of *ownership, jurisdiction and control* also need clarification.[5] This is specifically relevant in the context of new industries like active debris removal and on-orbit servicing and the large number of objects in Low Earth Orbit (LEO). If ownership, jurisdiction and control are 'eternal', as the space treaties suggest, objects cannot be abandoned at the end of their useful life and the debris removal industry would need to make sure they have the proper authorizations in place before they proceed with their activity. Contrary to, for instance, the shipping industry, it seems that the specific characteristics of the outer space environment, such as its remoteness, the absence of sovereignty and the complexities of low gravity,

1 Art. II and III of the Convention on International Liability for Damage Caused by Space Objects, adopted 29 Nov. 1971, entered into force 1 Sept. 1972 (hereafter Liability Convention).

2 Art. I(d) of the Liability Convention and art. I(b)of the Convention on Registration of Objects Launched into Outer Space, adopted 12 Nov. 1974, entered into force 15 Sept. 1976, 1023 UNTS 15 (hereafter Registration Convention).

3 Art. III of the Liability Convention.

4 See https://docs.pca-cpa.org/2016/01/Permanent-Court-of-Arbitration-Optional-Rules-for-Arbitration-of-Disputes-Relating-to-Outer-Space-Activities.pdf. The author was appointed by the Netherlands as arbitrator, see https://pca-cpa.org/en/about/panels/panels-of-arbitrators-and-experts-for-space-related-disputes/ (both accessed in November 2022).

5 Art. VIII of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, adopted 19 Dec. 1966, entered into force 10 Oct. 1967, 610 UNTS 205 (hereafter Outer Space Treaty).

are best served by such eternal ownership, jurisdiction and control which provide stability, while industry should find other means to secure its business model.

The principle of *due regard* and the meaning of *harmful interference* are further examples of concepts that require clarification.[6] The meaning of due regard can be inferred from public international law discourse on this topic. It likely implies a certain standard of care and entails 'a duty to cooperate, to strike the most appropriate balance between the divergent rights or obligations at stake.'[7] Harmful interference with the activities of other States is not *per se* prohibited, but if there is a chance that it may occur, States are required to undertake appropriate international consultations. Although harmful interference certainly has occurred, as illustrated by the issues caused by large constellations to astronomical observations that were addressed in chapter VI, it seems that so far, no request for international consultations has been issued.[8] Having a clear set of 'rules of the road' in the form of a Space Traffic Management (STM) regime, guidelines for decommissioning of satellites at the end of their useful life and increased tracking capability would go a long way in avoiding harmful interference, but this is currently not available.

These are just a few examples of *current* challenges posed by debris mitigation and the long-term sustainability of space activities, and of *mid- to longer term* challenges such as those posed by large constellations and the potential incompatibility between several legitimate uses of outer space. The legal framework for space activities needs to be equipped with additional tools to address these challenges.

2 Supplementing Space Law

In terms of the need to *supplement* the current framework, any innovative use of outer space will bring new legal questions. For instance, *space resource utilisation* requires an answer about the legality of owning space resources in the context of the non-appropriation principle.[9] If ownership of space

6 Art. IX of the Outer Space Treaty.

7 Mathias Forteau, 'The Legal Nature and Content of "Due Regard" Obligations in Recent International Case Law', *34 The International Journal of Marine and Coastal Law 1* (2019), p. 25-42. In the context of space law, see Michael Mineiro, 'Article IX's Principle of Due Regard and International Consultations: An Assessment in Light of the European Draft Space Code of Conduct', *Proceedings of the International Institute of Space Law 2010* (Eleven Publishing, 2011), p. 674-686.

8 Interestingly, in 2021 China used art. V of the Outer Space Treaty to notify the UN about preventive collision avoidance between the China Space Station and 2 Starlink satellites, rather than requesting the US to enter into consultations via art. IX. *Note verbale dated 3 December 2021 from the Permanent Mission of China to the United Nations (Vienna) addressed to the Secretary-General,* A/AC.105/1262.

9 Art. II of the Outer Space Treaty.

resources were to be interpreted as illegal, then the adoption by consensus of the Moon Agreement in 1979 would make no sense, because this treaty addresses exactly that: the use of space resources.[10] At the time of writing, four States have national legislation addressing this question (viz., the USA, Luxembourg, the United Arab Emirates and Japan), but that is not an ideal solution and may result in fragmentation. A way must be found to confirm whether the global community of States agrees that ownership of resources is not prohibited, and interpretation of a treaty should be carried out by its States Parties in accordance with the rules of treaty interpretation contained in the 1969 Vienna Convention on the Law of Treaties.[11] Of course, admitting that owning space resources is not illegal does not mean that there are no conditions or limitations to such ownership. The development of those conditions and limitations is the law-making challenge we are faced with. An example is the creation of 'safety zones' around mining operations on celestial bodies, which may be necessary to ensure safety and could be seen as a way of exercising 'due regard', as suggested in NASA's Artemis Accords.[12] But rules will be needed about their size, duration and scope, as well as their registration and recognition by other stakeholders, otherwise such zones would be worthless in an international context. A parallel can be made here with the regulation of the Geostationary Satellite Orbit (GSO), where slots and frequencies are allocated to users following a strict process of notification, coordination, publication and registration in the master international frequency register. The system only works if it is managed by an independent global authority, such as in this case the International Telecommunication Union.[13]

Another example is the duty to ensure that exploration and use of space resources are carried out 'for the benefit and in the interests of all countries.'[14] This is perhaps the most demanding and complex challenge to solve.[15] The Hague International Space Resources Governance Working Group included the topic in its Building Blocks, proposing that 'the international framework should provide that States and international organizations responsible for space resource activities shall provide for benefit-sharing through the promotion of the participation in space resource activities by

10 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, adopted 5 Dec. 1979, entered into force 11 July 1984, 1363 UNTS 3 (hereafter Moon Agreement).

11 See arts. 31 and 32 of the Vienna Convention on the Law of Treaties (adopted 23 May 1969, entered into force 27 Jan. 1980), 1155 UNTS 331.

12 *Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes* (Artemis Accords), sec. 11, available at https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf (accessed in November 2022).

13 See Tanja Masson-Zwaan and Mahulena Hofmann, *Introduction to Space Law* (2019) at p. 142-144.

14 Art. I of the Outer Space Treaty.

15 See on this matter Michael Simpson, 'Benefit in Space Law: Principle and Pathway', *45 Air & Space Law* (2020), p. 143-156.

all countries, in particular developing countries.'[16] The Building Block lists the following examples of benefits, and, interestingly, the Working Group considered that compulsory monetary benefit sharing should not be required:

> 'enabling, facilitating, promoting, and fostering: a) The development of space science and technology and of its applications; b) The development of relevant and appropriate capabilities in interested States; c) Cooperation and contribution in education and training; d) Access to and exchange of information; e) Incentivization of joint ventures; f) The exchange of expertise and technology among States on a mutually acceptable basis; g) The establishment of an international fund.'[17]

There are also more practical issues related to space resource utilisation that need a legal answer. An object made solely from lunar material without being launched into Earth orbit or beyond, perhaps best qualified as a 'space-made object'[18], does not seem to fall under the definition of 'space object' in the context of the 1974 Registration Convention, which extends the obligation to register only to objects 'launched into Earth orbit or beyond'.[19] Following that reasoning, bricks made of lunar regolith for the construction of a lunar base,[20] or rocket propulsion fabricated from lunar ice[21] would not need to be registered with the UN or in a national registry because they have not been launched into Earth orbit or beyond. One might argue that the bricks are a 'component part' of the 3-D printer that made them and that was launched from Earth, but this reasoning may be a bit far-fetched. It also does not seem pragmatic to register space-made bricks in the UN registry or a national registry. It seems even less realistic to register rocket fuel made from lunar ice. But it may be desirable to find other means to identify and

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16 The Hague International Space Resources Governance Working Group, *Building Blocks for the Development of an International Framework on Space Resource Activities,* November 2019, Building Block nr. 13 ('Sharing of benefits arising out of the utilization of space resources'), see https://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-of-air-space-law/the-hague-space-resources-governance-working-group (accessed in November 2022).

17 *Ibid*.

18 This term was coined by the Hague International Space Resources Governance Working Group in its Building Block 2.5: 'Space-made product: a product made in outer space wholly or partially from space resources', adding, in a footnote: 'According to the understanding of the Working Group, this excludes raw mineral and volatile materials, including water, irrespective of form', *ibid*.

19 Art. II of the Registration Convention.

20 Lunar regolith is the dust, soil and rock on the Moon's surface, see, e.g., ESA, *Powering the future with lunar soil* (2019), https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Discovery_and_Preparation/Powering_the_future_with_lunar_soil (accessed in November 2022).

21 See, for instance, NASA, *CubeSat to Demonstrate Water-Fueled Moves in Space* (2021), https://www.nasa.gov/feature/ames/ptd-1. The US company Orbit Fab is planning to build gas stations in space, see https://www.orbitfab.com/ (both accessed in November 2022).

record such 'space-made' objects, to ensure transparency. Whether liability for the compensation of damage under the 1972 Liability Convention could attach to such objects may be less questionable at first sight, since for liability to attach to an object there is no requirement of it being launched into Earth orbit or beyond. However, a launching State would still need to be identified, and usually the State of registry is the launching State that is easiest to identify since only a launching State may register a space object.[22] It is doubtful that a lunar brick or rocket fuel made from lunar ice have a launching State at all and therefore it may be difficult to identify a liable State in case of damage occurring because of space-made objects. Clearly, additional rules regarding registration and liability for space-made products will be necessary.

Private human spaceflight and *suborbital flights* may bring the question of the definition and delimitation back to the table and may require the adoption of a special regime borrowing from two areas of law that so far were separate. The fact is that such flights are already happening, and although they are initially taking place within the jurisdiction of one State, the USA, which has developed a regulatory framework that suffices for the time being, flights will at some point be crossing national borders, requiring an international legal regime. More States are starting to facilitate such flights and are drafting legislation, and some harmonisation of national regimes is desirable to ensure clarity and transparency. The legal status of, and the chain of command among the persons on board must be clarified, as well as applicable liability regimes, insurance obligations, security provisions and more. Earlier efforts by ICAO and UNOOSA to find solutions that satisfy concerns about safety as discussed in chapter X have so far not garnered tangible results, and more work is needed not only on the substantive law but also to determine which body will be charged with oversight and implementation of the regime.

Complementing the current framework is also needed to solve the challenges of *increased use* of outer space and to satisfy the growing call for long-term sustainability of space activities. For instance, with regard to large constellations, a trend can be observed towards stricter requirements on end-of-life decommissioning and an increased need for tracking mechanisms and improved space situational awareness.[23] The developments in the field of STM in various regions in the world form another example.[24]

22 Art. II of the Registration Convention.

23 A good example is the 5-year rule to de-orbit satellites at the end of their life, adopted by the US Federal Communications Commission in September 2022 to replace the decades-old 25-year rule. See https://www.fcc.gov/document/fcc-adopts-new-5-year-rule-deorbiting-satellites (accessed in November 2022).

24 For instance, US Space Policy Directive-3, *National Space Traffic Management Policy* of June 2018 and the ambition of the EU expressed in the *Joint Communication to the European Parliament and the Council, An EU Approach for Space Traffic Management*, JOIN (2022) 4 final, European Commission and High Representative of the Union for Foreign Affairs and Security Policy, 15 February 2022 (hereinafter referred to as Joint Communication).

Likewise, practical matters such as the process of registering satellites launched into outer space must be improved to remain manageable, possibly by means of automation or artificial intelligence.

The needs for additional space law related to the use of space resources, private human spaceflight and to meet the challenge of sustainability demonstrate how *new, innovative and increased uses* of outer space necessitate additional rules to solve issues that were not envisaged in the 1960s and 1970s.

3 Ways and Means

An important question is *how* the clarifications and supplements of space law that were described above should be implemented. There are several ways which can, or perhaps should, be applied simultaneously. In my view, one method should be avoided, and that is the amendment of the current UN space treaties. Opening these up for even a minor amendment runs the risk of opening a Pandora's box and would lead to the loss of a system that has worked well and can continue to work. The large number of States that need to reach consensus[25] and the great divisions that characterise the current geopolitical landscape require great caution. It is a good sign that no State has ever suggested an amendment to, and no State has ever withdrawn from any of the UN space treaties.

Looking at what other means would work, it seems clear that the adoption of new space treaties is unlikely in the near term. Therefore, the best method to solve these challenges lies in the adoption of 'soft law' in the form of UN resolutions, sets of guidelines or industry best practices. However, to be a realistic and successful alternative to 'hard law', the quality and efficiency of these secondary international law sources, as well as States' willingness to apply and enforce them, must be ensured. Soft law will only be useful if it can stand up to the test of being applied and enforced and if it can overcome the barriers of politics, deadlocks and other forms of stagnation like those experienced in the Conference on Disarmament. To be able to meet the challenge and to remain relevant in the future as a global forum for space-law making, UNCOPUOS should find a way to take social, cultural and commercial interests and views of non-State stakeholders into account. The working groups established by the two Subcommittees where non-State stakeholders can be heard is a step in the right direction, but they remain under the umbrella of the COPUOS Member States. The formula which the International Telecommunication Union (ITU) adopted with the introduction of over 900 non-voting Sector Members, Associates, and

25 At the time of writing, UNCOPUOS has 100 member states, see https://www.unoosa.org/oosa/en/members/index.html (accessed in November 2022).

Academia in addition to the 193 Member States is excellent.[26] This group includes companies of all sizes, active in different sectors of the economy, and universities from all over the world. This distinctive feature of the ITU merits further research, to see if such multistakeholder processes could be applied in other UN bodies like COPUOS as well.

Considering more specifically the issues identified among *current and future challenges*, the clarification of treaty terms needs to be effectuated by States Parties to the treaties. This clarification could be realised by means of official statements in UNCOPUOS, consistent State practice, and other means. States could for instance include in their official statements an expression about their understanding of the concept of space object, the meaning of fault or due regard, and what constitutes harmful interference. If enough States make such statements in a harmonious way, the interpretation may gain traction and eventually become generally accepted among the parties. In any case, only interpretation by the States Parties to a treaty has legal significance, but State practice and inclusion into national law can also help reach a global understanding. It seems that most of the clarifications identified above should be relatively non-contentious and should be realisable. Having confirmation that space debris is still a space object, that fault can be constituted or alleviated by certain actions such as de-orbiting at end-of-life, and that ownership cannot be abandoned so that permission must be obtained before an object can be removed from orbit will greatly contribute to legal certainty and clarity. Another means by which these clarifications can be achieved is by adjudication by an international judicial body such as the International Court of Justice. However, it does not seem likely that this will happen unless an extreme case of damage occurs, such as loss of life.

To facilitate and encourage the active debris removal industry, it is advisable to first focus on removing debris of actors within the same jurisdiction. As the industry matures, contracting can be a good way to ensure the company acts in compliance with the space law principles, such as ownership, jurisdiction and control. Contracts that clarify liability and insurance issues will help in reducing uncertainty.

Regarding large constellations, States must be encouraged to use the tool offered by article IX of the 1967 Outer Space Treaty and request international consultations when harmful interference with their own space activities, such as astronomy, occurs. Although it could be argued that asking for such consultations could be contentious, and create tension, they can be a politically harmless means to clarify matters in a diplomatic setting and help create awareness about the interests of different stakeholders.

States should also be reminded of their responsibility under article VI of the 1967 Outer Space Treaty, requiring their authorisation and supervision of the activities performed by their nationals. Possibly, stricter audits and

26 See https://www.itu.int/hub/membership/our-members/ (accessed in November 2022).

stakeholder consultations should form part of that process, and environmental impact assessments could be carried out. UNCOPUOS or bodies like the International Law Association could assist this process of a more robust authorisation and supervision process by proposing further guidelines for the implementation of article VI in the form of model national space legislation.

Looking at the issues raised by *future opportunities* such as *space resource utilisation*, the adoption of even more national laws confirming that private entities may own space resources is not desirable. The laws adopted by especially the USA, and to a lesser extent those adopted by Luxembourg, Japan and the UAE, were perhaps necessary to convince the international community that this topic requires its attention, but now it is time to ensure a global, equitable regime governing the use of space resources. Every effort should be made to facilitate the work of the COPUOS space resources working group, and the chairs of that working group should make efficient use of the considerable work done by various multistakeholder groups in the past five years, such as the Hague Building Blocks. The first impressions of their work allow for some optimism. At the same time, efforts should also continue to encourage States to join the 1979 Moon Agreement, while multilateral non-legally binding political agreements such as the Artemis Accords can also contribute to building consensus towards international agreement.[27] It should be encouraged that alternative 'coalitions of the willing', such as the Sino-Russian collaboration towards an International Lunar Research Station do the same; this may help to eventually foster global agreement in fora like COPUOS in a constructive manner. Questions arising from space-made products, including registration and liability, as well as practical implementation, registration and recognition of safety zones and the realisation of an equitable sharing of benefits require international answers to ensure transparency and mutual recognition.

For *human spaceflight*, it is anticipated that eventually a *sui generis* regime will emerge to govern suborbital flights as they fit neither in air law nor in space law, but that for the time being national law suffices. A solution to the issue of the definition and delimitation of outer space is not to be expected anytime soon since consensus is unlikely because several major space actors do not see a need for it, and it is therefore preferable to focus on other solutions such as a *sui generis* regime. The legal status of persons on board spacecraft, whether orbital or suborbital, will also gradually be solved, learning from precedents such as the Crew Code of Conduct for the ISS which for the first time creates a chain of command among persons on board a spacecraft.[28] Liability issues will likely initially be solved via contract.

Questions related to *safety and security* ideally require international regulation, even if only by means of soft law, but due to the dual-use and national security aspects of these issues it cannot be excluded that national and regional initiatives will continue to prevail for the time being. The

27 *Supra* n 12.

28 Available at 14 CFR § 1214.403 (USA).

importance of international coordination in these fields must be stressed wherever possible. For *long-term sustainability* of space activities, the situation is slightly different, possibly because the topic is less sensitive. Ten years of hard work in COPUOS have resulted in detailed guidelines that States are requested to implement at the national level and then report the results to COPUOS. This request could be seen as 'top-down-up' approach ensuring transparency and possibly even harmonisation, that may be an interesting example to follow. In parallel, industry initiatives such as the Net Zero Space Declaration[29] and the Space Sustainability Rating[30] are to be welcomed. Another good example of 'bottom up' initiatives is the report issued by the World Economic Forum and McKinsey in May 2022, titled 'The role of space in driving sustainability, security, and development on Earth', suggesting five actions leaders can take to contribute to economic development, advance global security and sustainability, and make space a safe and globally accessible domain.[31] Of those five actions, the first immediately recognises the importance of governance and regulation ('create and implement effective space governance').[32] These initiatives demonstrate the global awareness of the need for action at the level of all stakeholders, whether States or private entities, and that means there here as well, there is reason for hope.

4 The Role of National Legislation

In addition to the further development of space law through soft law adopted at international level, to some extent, where appropriate and feasible, space law can also be further clarified and supplemented through the adoption of national law. National law is especially relevant for States to implement their obligation of authorisation and supervision under article VI

29 The *Net Zero Space Declaration* was launched at the 2021 Paris Peace Forum in a session moderated by the author. The International Institute of Air and Space Law at Leiden University is one of the early subscribers, committing to educate young space lawyers about the legal implications of debris and ways to mitigate and remediate it. See https://parispeaceforum.org/en/initiatives/net-zero-space/ and https://www.universiteitleiden.nl/en/news/2021/11/iiasl-aanwezig-bij-lancering-duurzaamheidsinitiatief-net-zero-space (accessed in November 2022).

30 *Space Sustainability Rating* (SSR), https://spacesustainabilityrating.org/. The author is a member of the SSR advisory group. The first rating was issued in June 2022, see https://spacesustainabilityrating.org/space-sustainability-rating-now-live/ (both accessed in November 2022),

31 Available at https://www.mckinsey.com/industries/aerospace-and-defense/our-insights/the-role-of-space-in-driving-sustainability-security-and-development-on-earth, (accessed in November 2022). The author was a member of the Advisory Board of this project.

32 The other four recommended actions are: invest resources and effort in enabling technologies and capabilities; incentivize collaboration among nations, sectors, and industries; foster a self-sustaining industrial base; and leverage the space sector more to advance sustainability and security.

of the 1967 Outer Space Treaty. Examples of questions for which national regulation is suitable include the licensing conditions for private commercial space activities, such as insurance obligations, the right of recourse of the State in case it is held liable for damage, or the information that must be provided for the registration of space objects. In addition, once international agreement has been reached on the questions of safety, sustainability, or equitable sharing of benefits, the details of such agreement will have to be transposed into national law, to ensure that private entities comply with them as well.

Although the role of the national legislator is becoming more relevant as private entities are more active, less than one quarter on the UN members, i.e., around forty States, have adopted national space legislation.[33] Efforts to increase this number are undertaken by the UN in its capacity-building activities such as the UN conferences on space law and policy and the UN workshops on space law.[34] In 2020 the UN launched the 'Legal Advisory Project on Space Law for New Space Actors', and with the help of several donor countries and organisations, technical advisory missions have been carried out for countries in Africa and the Asia-Pacific.[35]

Besides encouraging more States to adopt national legislation to implement their authorisation and supervision obligations, it is important to emphasise that thought must be given to the implementation of the national law, for instance by delegating authority to a special agency or by engaging external experts. Furthermore, States must be reminded that it will be necessary to regularly test the robustness of the law against new developments, such as the adoption of the 2019 COPUOS long-term sustainability guidelines. In other words, the adoption of a national law is never the end goal; it is a continuous process of testing and adapting where needed.

The UN efforts mentioned above, along with the 2013 UN resolution on national space legislation[36] and the model national space law of the International Law Association, [37] should go a long way in ensuring harmonisation of national laws. Strict harmonisation is not necessary but aspects such as safety need to be coordinated at the global level. Regional organisations

33 See *National Space Law*, UNOOSA, https://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/index.html (accessed in November 2022)

34 See https://www.unoosa.org/oosa/en/ourwork/spacelaw/conferences.html and https://www.unoosa.org/oosa/en/ourwork/spacelaw/workshops/index.html respectively (both accessed in November 2022)

35 See https://www.unoosa.org/oosa/en/ourwork/spacelaw/capacitybuilding/advisory-services/index.html. The 2017 *Handbook for New Space Actors*, published by Secure World Foundation and translated in Spanish (2020) and Chinese (2021) should also be mentioned here, see https://swfound.org/handbook/ (both accessed in November 2022).

36 A/RES/68/74, *Recommendations on national legislation relevant to the peaceful exploration and use of outer space* (December 2013).

37 International Law Association (ILA), *Sofia Guidelines for a Model Law on National Space Legislation* (2012), available at https://www.ila-hq.org/en_GB/documents/52nd-copuos-lsc-2013-sofia-guidelines-for-a-model-law (accessed in November 2022).

such as the EU can also play a role in this context by encouraging their members to accede to the UN space treaties, but for such a call to action by the EU to be credible, it will first need to make its own declarations of acceptance of the treaties, which seems to be in the plans.[38] Coordination among similar-sized and like-minded space-faring countries is also a useful and practical way to not only learn from each other's models, but also to promote harmonisation. A good example is the informal Nordic Space Authority Network Group, where Denmark, Finland, The Netherlands, Norway and Sweden meet annually to discuss and exchange views on matters of common interest.

With all these mechanisms in place and being planned, it seems that national space legislation can constitute a useful additional means to further clarify and complement space law. This is to be seen as a pragmatic solution to some of the issues identified in this study, especially those related to the role and activities of private commercial entities, which fall under the jurisdiction of States. The example of The Netherlands elaborated in part C of this study has demonstrated that national law can be a powerful tool for ensuring compliance of private actors with international space law, as long as it is efficiently implemented and regularly reviewed and updated when necessary.

Despite this generally positive outlook for national space law, it must be reiterated that certain challenges, such as long-term sustainability, safety and the equitable sharing of benefits, require international regulation, even if only through soft law, as they regard humanity as a whole and global compliance with a uniform set of rules is a prerequisite for the peaceful exploration and use of outer space for the benefit of all countries and humankind. It is therefore of utmost importance to continue to strive for global agreement on these issues in fora like UNCOPUOS. And once international agreement is reached on those global questions, the agreed rules should be transposed into national law to bind private entities.

5 Final Thoughts

This study ends with a final thought about some concerning developments that are taking place since 2007, which are affecting the use and exploration of space and may have an impact on the way forward for progressive space law development described above. Four States have conducted anti-satellite (ASAT) weapon tests in outer space between 2007 and 2021, which have not only resulted in vast amounts of space debris but also created

38 Joint Communication, *supra* n. 24 at para 6.1, p.13. The European Parliament expressed its support for this plan, see *European Parliament resolution of 6 October 2022 on an EU approach for space traffic management - an EU contribution addressing a global challenge*, (2022/2641(RSP)) at F.15.

geopolitical tensions.[39] Likewise, the deployment of 'inspector satellites'[40] and the increase in cyberattacks against space infrastructure by means of 'jamming' or 'spoofing' are concerning.[41] The illegal Russian invasion of Ukraine in February 2022 has caused an unprecedented backlash on international space cooperation, even putting the continued peaceful cooperation on the International Space Station (ISS) at risk.[42] Eight months into the war, it appears that space cooperation, which always seemed immune from geopolitical issues, indeed suffered to some extent from the war, but is once again proving more robust than expected and in September 2022 Russia even expressed that it is likely to continue its participation in ISS until 2028.[43] Likewise, the creation by the UN of the Open-ended Working Group on Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviours in 2021,[44] and unilateral declarations to stop ASAT tests by several States[45] give reason for hope for continued peaceful cooperation in space for the betterment of all humankind. But this cannot result from passive behaviour. As Schrijver put it in his valedictory lecture at Leiden University, the concept of peace has two sides, 'positive peace' and 'negative peace':

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39 China, the USA, India and Russia. Especially the deliberate destructions by China and Russia of their own satellites, in 2007 and 2021 respectively, created huge amounts of long-lasting space debris. See the useful infographic published by Secure World Foundation (2022), https://swfound.org/news/all-news/2022/06/swf-releases-new-infographic-on-anti-satellite-weapons-and-space-sustainability/ (accessed in November 2022),

40 See, e.g., Brett Tingley, 'Pentagon space chief condemns 'irresponsible' launch of Russian inspector satellite', *Space.com* (11 August 2022), https://www.space.com/russia-inspector-satellite-kosmos-2558-irresponsible-behavior (accessed in November 2022).

41 See for an explanation on jamming and spoofing satellite signals, Maya Posch, 'Knowing your place: the implications of GPS spoofing and jamming', *Hackaday* (23 May 2022, https://hackaday.com/2022/05/23/knowing-your-place-the-implications-of-gps-spoofing-and-jamming/ (accessed in November 2022).

42 See for an overview, Florin Zuba□cu, 'Ukraine war disrupting East-West cooperation in space', *Science Business* (8 March 2022), https://sciencebusiness.net/news/ukraine-war-disrupting-east-west-cooperation-space (accessed in November 2022).

43 See https://www.reuters.com/business/aerospace-defense/russia-is-likely-take-part-international-space-station-until-2028-ria-2022-09-21/ (accessed in November 2022).

44 See UN General Assembly resolution A/res/76/231 (24 Dec. 2021). See also https://meetings.unoda.org/meeting/oewg-space-2022/ (accessed in November 2022).

45 On 8 April 2022, US Vice President Kamala Harris announced that 'the United States commits not to conduct destructive, direct-ascent anti-satellite (ASAT) missile testing', https://www.whitehouse.gov/briefing-room/statements-releases/2022/04/18/fact-sheet-vice-president-harris-advances-national-security-norms-in-space/. Canada and New Zealand followed suit in May and July 2022, respectively, see https://spacenews.com/canada-joins-u-s-in-asat-testing-ban/ and https://spacenews.com/new-zealand-joins-asat-testing-ban/, whereas Germany and Japan joined in September 2022, see https://spacenews.com/japan-germany-declare-moratorium-on-anti-satellite-missile-tests/ (all accessed in November 2022).

> 'In traditional international law, peace is foremost the absence of war or the threat of war. This is the so-called 'negative peace', which also includes the avoidance of war […]
> [T]he world community should also aim to achieve positive peace, that is the promotion of justice in the world.'[46]

We owe it to the younger generations whose future lies in the sustainable expansion of humanity's footprint into the vast unknown to take up this task. We must continue to work towards 'positive peace' in space cooperation and to clarify, supplement and thus *widen the horizons* of outer space law.

46 Nico Schrijver, *Re-uniting for peace through international law*, Valedictory lecture, Leiden University (1 July 2022), p. 5, citing J. Galtung (n. 10).

Post Scriptum

At the start of my academic career at the International Institute of Air and Space Law, founded in 1985 by the late professor Henri A. Wassenbergh at Leiden Law School, I co-edited and contributed to a book titled 'Space Law: Views of the Future'.[1] Young scholars from all parts of the world were invited to write a chapter setting out their view of the future of space law, focusing on a variety of topics. That book did what organisations like *Space Generation Advisory Council*[2] do today for young professionals, including space lawyers: it amplified the voice of a new generation, a generation that needed its right to benefit from outer space to be safeguarded into the future.[3] The book addressed many of the topics that are also analysed in this study. It seems that thirty-five years later these same subjects concern us, but that does not mean no progress has been made. Indeed, in all those areas awareness has grown, and steps have been made at various levels, as evidenced in the papers included in this study. Much more work is needed, and fortunately space law continues to attract many bright young minds.

In his epilogue to the 1988 book, Wassenbergh wrote, with foresight:

> 'From the viewpoint of positive law, space law is imperfect in many ways and fields: the pace with which space technology is developing and in its wake the commercialization of outer space activities that is taking place, together with the growing possibilities of the inhabitation of outer space (space stations), the (de-) militarization of outer space and the further exploration of outer space are all factors which invite and necessitate new, amended and additional rules of positive international space law.'[4]

In my chapter, I wrote the following about my view of the future of space law:

> 'Imagination combined with practicality must be the starting point. The law has to be anticipated, but it must also be more specific to correspond with the complex situations and interrelations of today and tomorrow. The generalities of the past do not respond to the realities of today.'[5]

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1 Tanja L. Zwaan, Walter W.C. de Vries, Paul Henry Tuinder and Ilias I. Kuskuvelis (eds.), *Space Law: Views of the Future* (Kluwer, 1988).

2 See https://spacegeneration.org/ (accessed in July 2022). This author is a former member of the Advisory Board and current member of the Honorary Board, and a strong supporter of and advocate for SGAC.

3 The book had the following as its motto: 'Young birds cry out for the truth, while the old pine tree preaches wisdom'.

4 Zwaan *et al*., *supra* n. 1 at p. 143.

5 *Ibid*., at p. 37.

As a space lawyer who spent more than three decades in the field and gained experience and expertise on a plethora of space topics, and who educated hundreds of young lawyers from all over the world, I still stand with that statement about the field that has never stopped to fascinate and motivate me.

Original Sources

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Chapter II: The Peaceful Uses of Outer Space
The Oxford Handbook of United Nations Treaties, Simon Chesterman, David M. Malone and Santiago Villalpando (eds.), (Oxford University Press, 2019), pp. 181-198, DOI: 10.1093/law/9780190947842.003.0012
With Roberto Cassar, LLM (*cum laude*) in Advanced Studies in Air and Space Law, International Institute of Air and Space Law at Leiden University
(The author was the principal author of this chapter)

Chapter III: Space Debris
Introduction to Space Law, T. Masson-Zwaan and M. Hofmann (Kluwer, 2019), pp. 109-119
(This chapter was written by the author)

Chapter IV: Sustainability in Space
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Samenvatting (Dutch Summary)

Verbreding van de Horizon van het Ruimterecht

Kort na de aanvang van het ruimtevaarttijdperk, met de lancering van Spoetnik 1 door de voormalige Unie van Socialistische Sovjetrepublieken (USSR) op 4 oktober 1957, kwamen Staten binnen de Verenigde Naties (VN) bijeen om te bespreken hoe hun activiteiten in de ruimte gereguleerd moesten worden. De belangrijkste zorg destijds was dat de ruimte voor vreedzame doeleinden behouden moest worden en dat een wapenwedloop in de ruimte voorkomen moest worden. Dit resulteerde in een sterke politieke wil om overeenstemming te bereiken over bepaalde gedragsprincipes. In deze geest kan het Ruimteverdrag van 1967, het eerste van vijf internationale ruimteverdragen die zijn aangenomen door het VN-Comité voor het vreedzaam gebruik van de ruimte (COPUOS), worden beschouwd als een vredeshandhavingsverdrag.

Ruimtevaartactiviteiten brengen *uitdagingen* met zich mee. Snelle technologische ontwikkelingen en commerciële initiatieven testen het wettelijke kader dat in de jaren zestig en zeventig werd overeengekomen om de activiteiten van een handvol Staten te regelen. De toename van zowel staats- als niet-overheidsactoren en van satellieten, vooral in lage aardbanen, maakt de ruimte steeds meer omstreden en overbelast, waardoor de duurzaamheid van ruimtevaartactiviteiten op de lange termijn op het spel staat. Ook zal het vermogen van Staten om private activiteiten te reguleren steeds meer op de proef worden gesteld.

De ruimtevaart brengt ook vele *voordelen* voor de mensheid. Particulier kapitaal en ondernemingszin kan grote kansen op het gebied van innovatie en creativiteit creëren die gunstig kunnen zijn voor de mensheid, op voorwaarde dat er een duidelijk, billijk en voorspelbaar wettelijk kader bestaat. Voorbeelden van zulke innovatieve projecten zijn de toepassingen van satelliettechnologie voor communicatie, aardobservatie en navigatie, het commerciële gebruik van ruimtebronnen, de exploitatie van commerciële ruimtestations of sub-orbitale vluchten.

Een fundamentele vraag is of het huidige wettelijke kader voor ruimtevaartactiviteiten nog voldoet of dat verduidelijking of aanvulling nodig is, en hoe die kunnen worden bewerkstelligd. Het huidige wettelijke kader heeft gezorgd voor een geschikt en flexibel systeem voor de eerste decennia van ruimtevaartactiviteit, en heeft geleid tot vreedzame samenwerking en het vermijden van een wapenwedloop in de ruimte. Maar sinds het Maanverdrag van 1979 is het niet mogelijk gebleken nieuwe afspraken te maken in juridisch bindende overeenkomsten (*hard law*). Dit heeft geleid tot het formuleren van nieuwe beginselen in niet-juridisch bindende instrumenten in de vorm van VN-resoluties en richtlijnen (*soft law*). Hoewel het sluiten

van nieuwe verdragen uiteraard altijd de voorkeur heeft biedt de combinatie van 'hard' en 'zacht' ruimterecht, bestaande uit verdragen, resoluties en sets van richtlijnen, een flexibel en vooralsnog gepast juridisch kader, dat bovendien kan worden geïmplementeerd via nationale wetgeving en daarmee bindend wordt voor private ruimtevaartactoren. Met andere woorden, de voortschrijdende ontwikkeling van het ruimterecht in de vorm van 'soft law' is vooralsnog geen groot probleem.

Het huidige kader brengt wel bepaalde uitdagingen mee. Zo is er een gebrek aan duidelijkheid en definities in de VN-ruimteverdragen. Er is meer duidelijkheid nodig over hoe private actoren passen in het staatgecentreerde kader, hoe zij gehouden kunnen worden aan de verplichtingen die Staten zijn overeengekomen en hoe hun belangen kunnen worden behartigd. Het ontbreken van definities en details in de verdragen draagt het risico dat innovatie wordt verstikt en dat er geen rechtszekerheid is. De nieuwe context van toegenomen private activiteiten in de ruimte betekent ook dat de rol van nationale regelgevingskaders steeds relevanter wordt.

De noodzaak van een constante afweging tussen bedreigingen en kansen, waarbij zowel de sterke als de zwakke punten van het huidige wettelijke kader voor ruimtevaartactiviteiten aan het licht komen, staat centraal in deze studie. Vooruitgang kan niet worden tegengehouden, en vereist een alomvattend, duidelijk, billijk en flexibel wettelijk kader dat tegemoetkomt aan de belangen van alle actoren en tegelijkertijd het veilige en duurzame gebruik van de ruimte garandeert. In het kader van de hierboven beschreven context is de centrale onderzoeksvraag van dit onderzoek de volgende: *Regelt het bestaande internationale juridische kader voor ruimtevaartactiviteiten de huidige en toekomstige uitdagingen op het gebied van gebruik, onderzoek en exploitatie van de ruimte adequaat, en zo niet, hoe kan dit worden verholpen?*

Die vraag is onderverdeeld in drie deelvragen. De eerste deelvraag is of het bestaande internationale juridische kader voor ruimtevaartactiviteiten de huidige en toekomstige uitdagingen van gebruik, onderzoek en exploitatie van de ruimte adequaat regelt, en komt aan de orde in *deel A* van het onderzoek, getiteld *Het wettelijk kader voor ruimtevaartactiviteiten: huidige en toekomstige uitdagingen*. De tweede deelvraag richt zich op de toekomst, en onderzoekt of het bestaande internationale juridische kader voor ruimtevaartactiviteiten de toekomstige mogelijkheden van gebruik, onderzoek en exploitatie van de ruimte adequaat regelt. Deze vraag komt aan de orde in *deel B* van het onderzoek, getiteld *Het wettelijk kader voor ruimtevaartactiviteiten: toekomstige kansen.* De derde deelvraag onderzoekt de situatie op nationaal niveau en neemt als voorbeeld Nederland, een kleine maar ambitieuze ruimtevaartstaat met een flexibel maar veelomvattend wettelijk kader. *Deel C* van de studie is getiteld *Het wettelijk kader voor ruimtevaartactiviteiten: Nederland*. De antwoorden op deze deelvragen worden samengevat in het *slotdeel*, getiteld *Een blik op de toekomst*.

De studie is verdeeld in dertien hoofdstukken, voorafgegaan door een inleiding (*hoofdstuk I*). *Hoofdstuk II* introduceert *deel A* en behandelt de achtergrond en geschiedenis van het ruimterecht, met een focus op het

Ruimteverdrag. Het vat de onderhandelingsgeschiedenis van dat verdrag en de vier daaropvolgende verdagen samen, en legt de belangrijkste beginselen uit. Het hoofdstuk geeft ook een blik op de toekomst van het ruimterecht, dat mogelijk zal evolueren in de vorm van 'soft law' in plaats van juridisch bindende verdragen.

Hoofdstuk III gaat in op een huidige uitdaging voor ruimtevaartactiviteiten, namelijk ruimtepuin. Het analyseert wat de VN-ruimteverdragen voorschrijven, alvorens over te gaan tot een bespreking van relevante 'soft law' instrumenten, zoals de COPUOS-richtlijnen voor het verminderen van ruimtepuin en het moeizame proces naar de adoptie van de COPUOS-richtlijnen voor lange termijn duurzaamheid van ruimtevaartactiviteiten. Het verwijderen van inactieve objecten uit de ruimte wordt ook kort behandeld.

Hoofdstuk IV bevat een transcript van de jaarlijkse Meijerslezing die de auteur in 2021 mocht geven. Het gekozen thema dat jaar was duurzaamheid en daarom stond de lezing in het teken van duurzaamheid in de ruimte. De tekst schetst de stand van zaken van ruimtevaartactiviteiten die het voortdurende voordeel van ruimteverkenning voor huidige en toekomstige generaties op de proef stelt. Verschillende initiatieven worden belicht, waaronder activiteiten van het Internationaal Instituut voor Lucht- en Ruimterecht van de Universiteit Leiden.

Hoofdstuk V verschuift de focus naar toekomstige uitdagingen en geeft inzicht in het onderwerp *Space Traffic Management* (STM). Het maakt vergelijkingen met het zee- en luchtrecht, die tot op zekere hoogte als model kunnen dienen voor de ontwikkeling van een STM-regime voor ruimtevaartactiviteiten, en benadrukt hoe en waarom verschillende principes in de ruimteverdragen relevant zijn in deze context. Het hoofdstuk beschrijft ook de ontwikkelingen binnen COPUOS, waar STM een formeel agendapunt is, evenals verschillende niet-gouvernementele initiatieven die aantonen dat private actoren zich terdege bewust zijn van de noodzaak van 'verkeersregels' voor ruimtevaartactiviteiten.

Hoofdstuk VI behandelt mogelijke conflicten tussen commerciële en wetenschappelijke ruimtevaartactiviteiten. Meer specifiek bespreekt het de verstoring door een grote satellietconstellatie van astronomische waarnemingen, die lijden onder de weerkaatsing van zonlicht door de satellieten. Het hoofdstuk geeft aan welke principes van de ruimteverdragen relevant kunnen zijn om dit probleem aan te pakken, bespreekt mogelijke technische oplossingen die door de industrie zijn voorgesteld en legt uit waarom de aanvankelijke juridische argumenten van de astronomische gemeenschap niet succesvol waren. Vervolgens doet het verschillende suggesties voor maatregelen op nationaal en internationaal niveau, zoals interventies onder relevante agendapunten in COPUOS door permanente waarnemers zoals de Internationale Astronomische Unie (IAU).

Hoofdstuk VII introduceert *deel B*, waarin wordt ingegaan op toekomstige kansen van de ruimtevaart die adequate regelgeving vereisen, en richt zich op het gebruik van maanhulpbronnen als een eerste voorbeeld. Het biedt een analyse van harde en zachte wetgeving die relevant is voor dit

actuele onderwerp en geeft een overzicht van de nationale wetten die door een aantal Staten zijn aangenomen bij gebrek aan rechtszekerheid in de VN-ruimteverdragen, zoals de VS in 2015. Het hoofdstuk gaat vervolgens in op de ontwikkelingen binnen COPUOS, waarbij de beginjaren van controversiële discussies sinds 2016 worden beschreven en een geleidelijke trend naar acceptatie van de rechtmatigheid van activiteiten op het gebied van ruimtehulpbronnen. Het hoofdstuk onderzoekt ook ontwikkelingen buiten COPUOS, zoals NASA's Artemis-akkoorden uit 2020 en niet-gouvernementele initiatieven zoals *The Hague International Space Resources Governance Working Group*, die in 2019 twintig bouwstenen heeft aangenomen voor de ontwikkeling van een internationaal kader voor activiteiten op het gebied van ruimtehulpbronnen. Ook hier wordt het belang van internationaal overleg in COPUOS benadrukt, ook al zal voortgang traag zijn.

Hoofdstuk VIII gaat verder in op dit onderwerp, in het Frans, de 'thuistaal' van de auteur vanwege haar internationale gezinssituatie, en één van de officiële talen van de VN. Het bevat vergelijkbare analyses en behandelt het proces in COPUOS dat in 2021 heeft geleid tot de oprichting van een werkgroep met een mandaat van vijf jaar. De noodzaak een balans te vinden tussen de belangen van investeerders en technologieontwikkelaars en een billijke verdeling van voordelen wordt benadrukt.

Hoofdstuk IX bespreekt de bemenste ruimtevaart en geeft een overzicht van orbitale en sub-orbitale bemenste ruimtevluchten. Wat betreft orbitale missies is het Internationale Ruimtestation ISS een uniek internationaal samenwerkingsproject tussen vijftien landen dat wordt gereguleerd door een innovatief wettelijk kader dat als model kan dienen voor toekomstige coöperatieve nederzettingen in de ruimte of op hemellichamen. Sub-orbitale vluchten zijn juridisch complexer, aangezien zij plaatsvinden op de grens tussen lucht en ruimte, zonder dat er een formele juridische grens tussen beide is overeengekomen. De VS heeft nationale wetgeving uitgevaardigd om deze activiteit te reguleren, net als op het gebied van ruimtehulpbronnen. De gevolgen van de toepassing van internationaal lucht- of ruimterecht worden samengevat en de acties van en interacties tussen de Internationale Burgerluchtvaart Organisatie (ICAO) en UNOOSA worden toegelicht. Het hoofdstuk concludeert dat een besluit over de toepasselijke wetgeving nodig is om deze industrie op een economisch en technologisch haalbare en veilige manier te laten ontwikkelen en democratische toegang tot de ruimte waar te maken met het oog op toekomstig snel vervoer van punt A naar punt B op aarde via de ruimte.

Hoofdstuk X gaat dieper in op sub-orbitale vluchten en behandelt twee specifieke aspecten die verduidelijking behoeven, namelijk aansprakelijkheid, zowel contractuele aansprakelijkheid als aansprakelijkheid ten opzichte van derden, en verzekeringen. Het hoofdstuk speelt zich af tegen de achtergrond van de succesvolle vluchten van de twee grote spelers in deze branche in 2021, Virgin Galactic en Blue Origin, die de noodzaak van wetgeving benadrukken. Het hoofdstuk analyseert de rollen van ICAO, de EU en UNOOSA, en licht het materiële recht op het gebied van aansprake-

lijkheid en verzekering toe. Het gaat dieper in op de gevolgen van toepassing van luchtrecht, met inbegrip van het EU-luchtvervoersrecht, die beiden goed ontwikkeld zijn inclusief een uitgebreide hoeveelheid jurisprudentie, of ruimterecht, dat een aantal relevante elementen op die gebieden mist. De ontwikkeling van een *sui generis* regime wordt aanbevolen als beste oplossing voor de langere termijn, hoewel tussentijdse oplossingen op basis van beide rechtstakken en de vaststelling van nationaal recht aanvaardbaar zijn voor de korte termijn.

Hoofdstuk XI is het eerste van drie hoofdstukken over Nederland, die *deel C* van het onderzoek vormen. Dit hoofdstuk geeft een gedetailleerd overzicht over registratie van objecten die in de ruimte zijn gelanceerd onder verschillende VN-documenten, en richt zich vervolgens op Nederland. Het beschrijft het wettelijk kader en geeft uitleg over de Nederlandse interpretatie van het begrip lanceerstaat. Verder wordt toegelicht hoe de reikwijdte van de Nederlandse wet in 2015 is uitgebreid naar ongeleide satellieten, die tot dan toe waren uitgesloten en dus geen vergunning nodig hadden, wat een onwenselijke situatie was.

Hoofdstuk XII geeft een nadere toelichting op de ontwikkeling van de regulering van kleine satellieten in Nederland, inclusief de marktontwikkelingen op dat gebied. Het beschrijft hoe aanvankelijk *ad hoc* oplossingen werden aangenomen voor universiteiten en startups om praktische problemen aan te pakken, en hoe de uitbreiding van het toepassingsgebied van de wet in 2015 een robuustere oplossing bood. Daarbij wordt een lager verzekerd bedrag voor schade in de ruimte gehanteerd, op voorwaarde dat de lancering is verzekerd binnen het lanceringscontract. Al met al getuigt dit van een pragmatische benadering om de naleving van verdragsverplichtingen te waarborgen, rekening houdend met de behoeften van belanghebbenden.

Hoofdstuk XIII geeft een praktisch overzicht van het Nederlandse wettelijke kader voor ruimtevaartactiviteiten, bestemd voor praktijkbeoefenaars en gericht op procedures, vergunningsprocessen en voorwaarden en vereisten, waaronder verzekeringen. Het legt de onderscheidende kenmerken van het Nederlandse wettelijk kader uit en bevat een paragraaf over actuele ontwikkelingen en een toekomstperspectief.

Tenslotte biedt het afsluitende deel van de studie antwoorden op de onderzoeksvragen en een blik op de toekomst (*hoofdstuk XIV*). Het is duidelijk geworden dat hoewel er een basisrechtskader bestaat, dit niet alle huidige en toekomstige uitdagingen en kansen kan aanpakken. Het wettelijk kader dat tijdens de eerste zestig jaar van de verkenning van de ruimte zorgvuldig is opgebouwd, is van onschatbare waarde en moet worden behouden. Maar het is niet robuust genoeg om op een duurzame en veilige manier alle nieuwe vragen te beantwoorden die ontstaan vanwege het snelle tempo waarin de technologie zich ontwikkelt en door de toename en verscheidenheid aan actoren op dit gebied. Het bestaande juridische kader moet worden *verduidelijkt* en *aangevuld*, of met andere woorden, de *horizon van het ruimterecht moet worden verbreed*, om zowel huidige en toekomstige

uitdagingen als toekomstige kansen die het gebruik en onderzoek van de ruimte bieden te reguleren, en om een efficiënte en toekomstbestendige nationale implementatie van het internationale recht te waarborgen.

Een belangrijke vraag is *hoe* deze verduidelijkingen en aanvullingen gerealiseerd moeten worden. Er zijn meerdere manieren die gelijktijdig kunnen worden toegepast. Eén methode moet worden vermeden, en dat is amendering van de VN-ruimteverdragen. Als zelfs maar een kleine wijziging wordt voorgesteld bestaat het risico dat een systeem dat goed heeft gewerkt en kan blijven werken verloren gaat. Het grote aantal Staten dat tot overeenstemming moet komen en de verdeeldheid die het huidige geopolitieke landschap kenmerkt vragen om voorzichtigheid. Het heeft daarom de voorkeur voorlopig door te gaan met het aannemen van 'soft law', richtlijnen, resoluties op internationaal en regionaal niveau, het versterken van nationale kaders en zelfs *industry best practices*.

Multilaterale niet-juridisch bindende politieke overeenkomsten zoals de door NASA geïnitieerde Artemis-akkoorden kunnen bijdragen aan het bereiken van internationale overeenstemming. Alternatieve 'coalities van bereidwilligen' moeten hetzelfde doen; dit zal uiteindelijk helpen om op constructieve wijze globale overeenstemming te bereiken in fora als COPUOS. De ruimte is een internationaal domein, onderdeel van de *global commons*, waar samenwerking om overeenstemming te bereiken over gemeenschappelijke gedragsregels essentieel is. In tegenstelling tot de periode toen de verdragen werden aangenomen moeten we ernaar streven dat ook maatschappelijke, culturele en commerciële belangen meegenomen worden bij de ontwikkeling van toekomstige ruimtewetgeving.

De studie eindigt met een laatste gedachte over de recente geopolitieke ontwikkelingen die van invloed zijn op het gebruik en de verkenning van de ruimte en die ook impact hebben op de progressieve ontwikkeling van het ruimterecht. Vier Staten hebben antisatelliet (ASAT) wapentests uitgevoerd in de ruimte, die niet alleen hebben geleid tot enorme hoeveelheden ruimtepuin, maar ook tot spanningen op het militaire toneel. Het groeiende aantal 'spionagesatellieten' en cyberaanvallen op ruimte-infrastructuur is zorgwekkend. De illegale Russische invasie van Oekraïne in februari 2022 heeft een ongekende weerslag gehad op de internationale samenwerking in de ruimte, en heeft zelfs de vreedzame samenwerking op het ISS in gevaar gebracht. Acht maanden na de oorlog lijkt het erop dat samenwerking in de ruimte, die altijd immuun leek voor geopolitieke kwesties, inderdaad tot op zekere hoogte te lijden heeft van de oorlog, maar toch robuuster blijkt te zijn dan verwacht. Ook geven de oprichting door de VN van de *Open-ended Working Group on Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviours* in 2021, en unilaterale verklaringen van diverse Staten om ASAT-tests te stoppen, reden tot hoop op voortzetting van de vreedzame samenwerking in de ruimte ten behoeve van de gehele mensheid.

We zijn het de toekomstige generaties verplicht samenwerking in de ruimtevaart actief te blijven bevorderen en de horizon van het ruimterecht te verbreden door het te verduidelijken en aan te vullen.

Curriculum Vitae

Tanja Masson-Zwaan earned her LL.B. and LL.M from Leiden Law School of Leiden University. She obtained the Dutch university teaching qualification (*Basis Kwalificatie Onderwijs*) in 2014. She holds an appointment as Assistant Professor and Deputy Director of the International Institute of Air and Space Law (IIASL) at Leiden Law School since 2008. The research for this study was conducted between 2016 and 2022.

She was elected President Emerita of the International Institute of Space Law (IISL) in 2016, after having served on its Board of Directors for twenty-five years, the last nine of which as its President. She was appointed as Global Faculty at International Space University (ISU) in 2019 and was elected Vice-President for Science and Academic Relations of the International Astronautical Federation (IAF) in 2022.

Tanja has a solid understanding of space law and the space law-making process. Her frequent interactions with diplomats, government representatives, academics and entrepreneurs from all over the world have procured her with excellent diplomatic and negotiating skills, a profound understanding of geopolitical relations and an ability to consolidate diverging viewpoints towards consensus.

She advises the Dutch Government on space law issues since 2008, carries out research contracts for the European Commission and provides trainings for practicing lawyers and staff of international organisations. She attends the sessions of the Legal Subcommittee of COPUOS as observer since more than two decades. She co-founded the Hague International Space Resources Governance Working Group in 2016. Its Building Blocks for the development of an international framework on space resource activities, adopted in 2019, serve as major input for the work of UNCOPUOS in this field.

Tanja taught and mentored hundreds of students and young professionals representing the next generation of space lawyers in the context of her work at Leiden Law School and numerous guest lectures at universities worldwide. She is a strong advocate for a set of rules governing space activities that is sufficiently robust and enabling, while safeguarding the needs of future generations.

She co-authored the 4th edition of 'Introduction to Space Law' (Kluwer 2019) and serves on the Board of Editors of Kluwer's journal Air and Space Law and its series on Aerospace Law and Policy. She is an elected full member of various professional associations, such as the International Academy of Astronautics, the International Law Association, and the

Académie de l'Air et de l'Espace. She is a Board member of several organizations, including Open Lunar Foundation, Arizona State University's Interplanetary Initiative and Space Generation Advisory Council. She was a Member of the Founding Boards of the European Centre for Space Law and of Women in Aerospace Europe and served as member of the Advisory Committee of Secure World Foundation.

Tanja received several awards and is a Member of Honour of the Netherlands Space Society (NVR). In 2020 she received a Royal decoration as *Officer* in the Order of Orange Nassau for her work in the field of space law.

In the range of books published by the Meijers Research Institute and Graduate School of Leiden Law School, Leiden University, the following titles were published in 2021 and 2022

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The character of the use and exploration of outer space has changed dramatically since the first artificial satellite was launched in 1957. The question this research addresses is whether the existing international legal framework for space activities adequately regulates current and future challenges and opportunities of the use, exploration and exploitation of outer space, and if not, how this can be remedied. It answers these questions in a series of published articles.

Although the legal framework that was adopted by States since the 1960s is of immense value and must be preserved, the rapid pace at which technology advances and the increase and variety of actors in this field imply that it cannot address all challenges and opportunities in a sustainable, safe and secure manner.

The existing legal framework must be clarified and supplemented, and the adoption of soft law, guidelines, resolutions at international and regional level, as well as the reinforcement of national frameworks and industry best practices seems the most pragmatic way forward.

Outer space is an international realm and in formulating future space law it is essential to strive for a set of common rules of behaviour, including the views and needs of all stakeholders.

This is a volume in the series of the Meijers Research Institute and Graduate School of the Leiden Law School of Leiden University. This study is part of the Law School's research programme 'Exploring the Frontiers of International Law'.

ISBN 978-94-6421-977-7

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