Rosanna Hoffmann

Legislating the Final Frontier: Trends and Challenges of National Space Law

INTRODUCTION

The frontier of outer space has always been a compelling subject of interest, capturing the collective imagination of humanity for decades. Initially, the realm of space was not just a venue for scientific exploration and technological innovation; it was a theatre for geopolitical contestation, primarily dominated by established spacefaring nations. The Cold War era saw an intense race to assert supremacy in space exploration, leading to ground-breaking missions like the Apollo moon landings and the launching of the Sputnik satellite. During this period, the legal frameworks around space were primarily driven by these superpowers, and even though geopolitical turmoil encapsuled this era, consensus was still to be found, culminating in the Outer Space Treaty of 1967.

In recent decades, advancements in technology have made space more accessible, reducing costs and enabling the development of diverse space assets. This has allowed not only emerging economies to engage in space exploration and satellite deployment but also private entities, from major aerospace firms to small tech startups and academia, to expand their presence in space. This broadened participation has added complexity to the governance and legal aspects of space activities. Traditional space powers, contrast with newer and emerging spacefaring nations, must formulate their own space laws aligned with international treaties.

As space activities become more integrated globally, the need for evolving legal frameworks is evident, particularly for nations developing their space law capabilities. These frameworks must balance competitive interests,

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ethical standards, international commitments and environmental aspects. This chapter will delve into the realm of national space laws, trends and challenges, focusing on the key elements of a national space law, and looking into their national implementation. The 'New Space Era' is a period marked by burgeoning commercial activities, international cooperation and rapid technological developments.

THE NECESSITY FOR NATIONAL SPACE LEGISLATION

In an age where outer space is no longer the exclusive domain of a handful of advanced nations, the necessity for well-defined national space laws has never been more pressing. As a myriad of new actors – ranging from emerging nations to commercial entities – venture into space, there exists an urgent need for domestic legal frameworks to guide activities, ensure safety and alignment with international norms. These laws serve as the regulatory bedrock, enabling a harmonious blend of scientific exploration and commercial enterprise. By establishing clear legal frameworks and guidelines, national space laws aim to create a structured and responsible environment for all participants in the evolving landscape of space exploration and utilisation.[1] An increasing number of nations, buoyed by technological advancements and strategic imperatives, are entering this once-exclusive domain. Moreover, private entities and commercial ventures are also playing an increasingly pivotal role, further amplifying the need for well-defined regulatory frameworks.[2]

Given this backdrop, national space laws have become indispensable tools for governance providing the necessary legal framework to address a range of complex issues. These issues can encompass everything from launching satellites for telecommunication, weather monitoring and scientific research, to more advanced ventures like space tourism and asteroid mining. Therefore, these laws serve not only to facilitate domestic activities but also to ensure responsible

[1] Marboe 2015: 127.

[2] Von der Dunk 2020b: 228; Freeland–Jakhu 2017: 2.

behaviour and compliance with international norms and agreements.[3] The benefit of national legal norms lies in their direct applicability and enforceability, unlike obligations derived from public international law, which may not always be enforceable.[4]

The essence of a national space law is to provide a legal framework that is consistent with a state's obligations under international treaties while catering to its specific needs and interests in space. It defines rights and obligations pertaining to space activities under a state's jurisdiction.[5] Some national space laws include the establishment of a national space agency, the operation of a spaceport, the use and distribution of remote sensing data and much more.[6] Whilst there is no definition of a national space law, in a wider sense, it could include all national legislation that may be applicable to space activities.[7]

THE INTERPLAY BETWEEN NATIONAL SPACE LEGISLATION AND THE UNITED NATIONS SPACE TREATIES

The evolution of national space laws cannot be viewed in isolation but must be considered in the context of international space law. National space laws are underpinned by several core principles of the Outer Space Treaty of 1967, including the requirement for authorisation and continuing supervision of space activities by States, the principle of liability for damage caused by space objects, the obligation to avoid harmful contamination of space and celestial bodies, the duty to conduct all activities in outer space with due regard to the corresponding interests of all other States, and the need for States to register space objects with the appropriate national and international bodies, just to

[3] Tapio–Soucek 2022: 116–117.
[4] Marboe 2015: 128.
[5] Freeland–Jakhu 2017: 2.
[6] Hobe 2013: 86.
[7] Soucek 2016: 53.

name a few.[8] Later in this chapter, the trends and considerations that come with implementing the seven key elements of a national space law, laid forth by the United Nations (UN) General Assembly Resolution A/RES/68/74, will be delved into. This chapter will particularly focus on how these elements are applied in practice and some possible trends to be found.

National space laws are essentially the implementation of these international principles, translating broad treaty provisions into actionable mandates, enabling a state to effectively oversee commercial space activities, reduce unforeseen liabilities and ensure compliance with clear regulatory standards.[9] The Registration Convention requires states to furnish details regarding their space objects to the UN, a requirement that is often incorporated into national space legislation. This ensures transparency and aids in the tracking and identification of space objects, which is crucial for the sustainability and safety of space operations.[10] Liability issues are another area where international and national space laws intersect. The Liability Convention elaborates on the liability of states for damage caused by their space objects, a principle that is reflected in national laws by imposing insurance requirements on space operators to cover potential liabilities resulting from damages caused.[11] For example, the 2009 collision between the inactive Russian satellite Cosmos 2251 and the operational Iridium 33 telecommunications satellite resulted in thousands of pieces of space debris, prompting a complex legal dialogue concerning fault, liability and compensation. This incident, addressed through the mechanisms of both international space law and the national laws of the involved countries, underscored the critical need for robust legal frameworks to manage the challenges posed by space debris.[12]

8 Outer Space Treaty 1967.
9 Lyall–Larsen 2018: 415–416.
10 Registration Convention 1976.
11 Liability Convention 1972.
12 Koplow 2009: 1204–1205.

The Rescue and Return Agreement outlines the responsibilities of states regarding astronauts in distress and the return of space objects, principles that have been incorporated into national laws to facilitate cooperation and mutual assistance in space operations.[13] The interdependence between national and international space law is further exemplified when examining the case of satellite broadcasting and telecommunications. The International Telecommunication Union (ITU) allocates orbital slots and radio frequencies; however, national regulations detail the licensing and operations of satellites within those frameworks.

Moreover, the concept of "due regard" in the Outer Space Treaty and the requirement to avoid harmful interference have been interpreted in various national contexts to mean that states must not only prevent physical interference with the space activities of other states but also avoid any activities that would be detrimental to the sustainability of the space environment.[14] This principle was tested in the 2013 case of Ecuador's Pegaso satellite, which suffered a collision with debris from an old Russian rocket stage. While no liability was formally pursued, the incident highlighted the need for enhanced space situational awareness and debris mitigation strategies at both national and international levels.[15]

The establishment and enforcement of national space laws, thus, serve as a bridge between the objectives set within the international space treaties and the practical considerations of state interests and commercial aspirations. As nations and private entities venture further into space, national legislation must continually adapt, not only to uphold international standards but also to address novel situations that arise as humanity expands its presence in space.

[13] Rescue and Return Agreement 1968.
[14] Popova–Schaus 2018: 7.
[15] Marboe 2016: 14.

THE SEVEN KEY ELEMENTS TO CONSIDER IN A NATIONAL SPACE LAW

The General Assembly Resolution A/RES/68/74 on national space legislation was a result of comprehensive work by a dedicated working group under the Committee on the Peaceful Uses of Outer Space's Legal Subcommittee (COPUOS LSC). During its 52nd session in April 2013, the Legal Subcommittee of the UN COPUOS reached a consensus on a draft that would later form the basis for the UN General Assembly Resolution. The resolution aims to ensure that states implement obligations under international space law, including those set forth in the Outer Space Treaty of 1967. The resolution also encourages states not yet party to these treaties to consider ratification or accession in line with their domestic legislation, further underscoring the importance of incorporating these international principles into national laws. The resolution underscores the importance of national legislation in implementing the obligations under international treaties, fostering responsible and sustainable use of outer space.[16] The resolution outlines key elements crucial for national space laws, which will be explored in detail. These elements include: the scope of application, defining the reach of national laws; authorisation for non-governmental entities to conduct space activities; ongoing supervision of these activities; the registration of space objects; liability and insurance requirements to cover potential damages; ensuring safety in space operations; and guidelines for the transfer of ownership of space objects.[17]

Scope of application

Starting with the first key element, the scope of application in law delineates the boundaries within which legal provisions are effective. It defines the extent of activities, entities and circumstances under which a law is applicable. This

[16] United Nations General Assembly 2013; Brisibe 2013: 728–729.
[17] United Nations General Assembly 2013.

precision is crucial for both the authorities enforcing the law and those subject to it, providing a clear understanding of their rights, obligations and the legal framework guiding their actions.[18]

Under the lens of national space laws, the scope of application defines the legal jurisdiction of a country over space activities. It can include which activities, entities and objects fall under the purview of a specific national space law, based on factors such as the location of launch, the nationality of the operators and the registration of space objects.[19] The scope of application within national space laws can broadly be seen to encompass material scope, territorial jurisdiction and personal jurisdiction, each offering a framework to delineate the legal reach and applicability of these laws.[20] The material scope can include specific activities, operations, or subjects covered by the law. Within national space law, this might mean defining a range of activities from satellite launches to space exploration missions, aiming to clarify which operations are regulated under the law. Territorial jurisdiction, *jurisdictio ratione loci,* generally relates to the geographical extent of the law's applicability. It might only refer to activities within a country's territory or could extend to not only activities taking place within a country's territory, but also to those by its nationals, regardless of the location. Personal jurisdiction, *jurisdictio ratione personae,* pertains to who the law would *in concreto* apply to, potentially covering a broad spectrum of individuals and entities, from citizens to corporations and possibly foreign operators within a nation's jurisdiction.

In examining the scope of application of national space law, one also needs to consider the first sentence of Article VI of the Outer Space Treaty, which stipulates: "States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial

[18] De Man 2016: 93.
[19] Soucek 2016: 55.
[20] Gerhard 2009: 114.

bodies, whether such activities are carried on by governmental agencies or by non-governmental entities."[21] This provision underscores the international responsibility of states for activities conducted by their nationals in space. The interpretation of the term 'national activities' can be seen to include activities conducted by individuals or entities possessing the nationality of the respective state. In essence, states are held internationally accountable for space activities undertaken by their nationals, encompassing private companies and other legal entities.[22]

For instance, the Liechtenstein Space Act, similarly to other national space laws, outlines its jurisdiction to include not only activities launched from its territory but also those conducted by its nationals anywhere in the world.[23] The Finnish national space law's scope of application for example extends to space activities conducted within Finland's territory and those outside its territory if undertaken on Finnish-registered vessels or aircraft, or by Finnish citizens or legal entities incorporated in Finland.[24] Similarly, South Africa's Space Affairs Act encompasses a wide range of space activities, including launching, operation of launch facilities, and participation in activities that engage international conventions, treaties, or agreements ratified by South Africa. It applies to activities launched from South African territory and to legal entities incorporated or registered in South Africa involved in space activities abroad that entail international obligations or affect national interests.[25] A trend in the scope of application of national space laws is the increasing consideration of activities beyond traditional spacefaring, that is to say, national governmental activities, to include also private sector engagements and international collaborations, as well as to consider national activities beyond a country's borders.[26]

[21] Outer Space Treaty 1967.
[22] Tronchetti 2014: 26–27.
[23] Liechtenstein 2023.
[24] Finland 2018.
[25] South Africa 1995.
[26] Soucek 2016: 53.

Authorisation and continuing supervision

The second and third key element are considered together under Article VI of the Outer Space Treaty, which is predominantly seen as the core article within the treaty used to amplify the necessity and importance of implementing a national space law. The authorisation and licensing of non-governmental entities pertaining to space activities is reflected in the second sentence of Article VI, which stipulates that "the activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty".[27] This requirement underscores the importance of regulating private sector involvement in space endeavours to ensure compliance with international obligations and promote responsible behaviour in space exploration and utilisation.[28]

Article VI not only mandates state parties to ensure that non-governmental entities operating in outer space receive proper authorisation but also underscores the need for ongoing state oversight of these entities' activities, that is to say, continuing supervision.[29] The authorisation process for space activities is characterised by national evaluation that could encompass not only the technical and financial viability of proposed missions but also their conformity with international space law and potential environmental impacts.[30] The distinction between authorisation and supervision in the context of space activities lies at the core of the Outer Space Treaty, with each serving a distinct yet complementary function. Authorisation is the initial process by which a state evaluates and grants permission for non-governmental entities to undertake specific space activities.[31] This process can involve a comprehensive review of the proposed space activity, whilst supervision represents an ongoing oversight

[27] Outer Space Treaty 1967.
[28] Outer Space Treaty 1967; VON DER DUNK 2020a: 116–117.
[29] VON DER DUNK 2011: 14.
[30] TRONCHETTI 2014: 26–27.
[31] DEMPSEY 2016: 6.

mechanism that extends beyond the launch phase, encompassing the entire lifespan of a space mission. It ensures continuous compliance with the terms set forth in the authorisation process and helps oversee implementation of regulatory standards, and the mitigation of potential risks associated with space operations.[32]

The dynamic and undeniably hazardous environment of outer space necessitates sustained oversight of space activities to safeguard against unforeseen risks and to ensure the long-term sustainability of outer space activities. Ongoing supervision can be seen as paramount when addressing the challenges posed by the increasing complexity and commercialisation of space activities, particularly in ensuring that these activities do not conflict with international law or cause harm to the space environment. The role of supervision should also be seen in the context of international responsibility and liability, as states must not only authorise but also continuously supervise their non-governmental space actors to fulfil their obligations under international space law.[33] In essence, while authorisation provides the legal basis for conducting space activities, ongoing supervision ensures that these activities remain compliant, safe and responsible throughout their duration.

In France, the process governing the authorisation and supervision of space activities is delineated under the Space Operations Act of 2008,[34] which sets out the requirements for both the initiation and ongoing management of space missions by non-governmental entities. The authorisation process for space activities in France requires a submission from non-governmental entities seeking to conduct space operations, which must, among other components, detail mission objectives, technical and safety plans, and environmental impact assessments. The French Space Agency (CNES), tasked with evaluating these submissions, aims to identify whether they meet safety, security and

[32] Gerhard 2009: 119.
[33] Spencer 2009: 78–79.
[34] France 2008.

environmental standards.[35] Once authorisation by the relevant Ministry is granted, the supervision phase ensures that space operations adhere to their authorised parameters throughout the mission duration. France's authority to adjust, suspend, or revoke licences if non-compliance is detected ensures that space operations that deviate from their authorised course can be addressed to mitigate risks to public safety and security.[36]

The United Kingdom's Space Industry Act of 2018 outlines procedures for non-governmental entities seeking to undertake space activities, mandating demonstrations of safety, environmental sustainability, security and international compliance. This regulatory oversight is managed by the Civil Aviation Authority (CAA). The CAA is responsible for assessing the capabilities of applicants to conduct space operations in a safe and responsible manner.[37] The supervisory role of the CAA involves continuous oversight over licenced space activities to ensure adherence to operational standards and authorisation terms. This includes monitoring operations, requiring periodic compliance reports from licencees, and conducting inspections to verify compliance with safety and operational standards.[38] Furthermore, the CAA has the authority to investigate incidents that may pose risks to public safety or the environment.[39] Like the French Space Operations Act, an important aspect of this supervisory function is the CAA's power to withdraw a licence if a licencee fails to meet the conditions of their authorisation, or if there is a significant risk to public safety, national security or environmental sustainability.[40]

The frameworks established by both the French Space Operations Act and the U.K.'s Space Industry Act are just two examples of national implementation of Article VI of the Outer Space Treaty. Having authorisation and supervision procedures in place for national space activities can be seen

[35] France 2008; Tronchetti 2014: 31.
[36] Lazare 2013: 210–211.
[37] U.K. Space Industry Act 2018.
[38] Smith et al. 2021: 721.
[39] U.K. Space Industry Act 2018.
[40] U.K. Space Industry Act 2018.

as beneficial for a state as it ensures that operations are conducted within the framework of international law, thereby adhering to obligations enshrined in the Outer Space Treaty.[41]

Registration of space objects

Transitioning to the fourth key element, this sub-section delves into the realm of registration of space objects. This process, integral to ensuring accountability and transparency in the increasingly crowded outer space environment, is mandated *in concreto* by the Registration Convention, which necessitates that States Parties notify the UN on specificities about each object they launch into outer space, including the object's launch date, orbital parameters and general function.[42] The Registration Convention extends the legal framework established by the Outer Space Treaty, particularly in reinforcing the principles of cooperation, mutual assistance, and the peaceful use of outer space by providing a method for identifying space objects, thereby facilitating the application of treaty provisions related to jurisdiction, control and liability.[43] It is, however, important to differentiate between two separate obligations within the Registration Convention, on the one hand, as mentioned above, it stipulates that states should notify the UN and include specific information listed within the Convention itself. On the other hand, the establishment of a national registry for space objects emerges as an additional fundamental obligation for States Parties.[44] This requirement is not merely procedural; it is a critical mechanism to ensure transparency, accountability and the effective management of space activities at national and international levels. The national registry acts as a comprehensive national catalogue of all space objects launched by a state. It is, however, up to each state to decide what

[41] Gerhard 2009: 123–124.
[42] Jakhu et al. 2018: 407.
[43] Schmidt-Tedd et al. 2013: 247; Soucek 2016: 38.
[44] Marboe 2015: 135.

information they wish to gather and include within the national registry.[45] The responsibility for registration falls on the 'launching State', defined as the state that launches, procures the launching, or from whose territory or facility the space object is launched.[46]

The necessity for a national registry is underscored by the increasing complexity and commercialisation of space activities. With the proliferation of private entities participating in space missions, the registry serves as a vital link between national governments and international space governance structures. It ensures that states can effectively exercise jurisdiction and control over their national entities, in compliance with Article VI of the Outer Space Treaty, which mandates state responsibility for national activities in outer space, whether conducted by governmental or non-governmental entities. Space object registration, jurisdiction and control, and state responsibility are undeniably interlinked.[47] Furthermore, the national registry facilitates the adherence to and implementation of international guidelines and best practices for space operations.[48]

In Sweden, the Swedish National Space Board is responsible for maintaining a register of space objects for which Sweden is deemed the launching state according to the Swedish Space Activities Decree of 1982.[49] If another state could also be considered a launching state, the space object is registered in Sweden only if there is an agreement between the involved states. One notable entry is Sirius 1, formerly BSB-1A, which was bought by a Swedish company in 1996 and subsequently entered into the Swedish Register after originally being launched and registered by the U.K. The satellite, initially registered in the U.K. as BSB-1A and launched from Cape Canaveral in 1989, was later acquired by Nordiska Satellitaktiebolaget and renamed Sirius 1, illustrating a case of

[45] Schmidt-Tedd et al. 2013: 260.
[46] Registration Convention 1975; Marboe 2015: 135.
[47] Soucek 2016: 38–39.
[48] United Nations Committee on the Peaceful Uses of Outer Space 2019.
[49] Sweden 1982.

cross-country space object management and registration transfer.[50] Transfer of ownership and national approaches will be delved into further below.

Under the Federal Law on Space Activity of 1993, Russian entities involved in space operations, including launching or operating space objects, are required to register these activities with Roscosmos.[51] Information about the space objects must be provided to Roscosmos one month prior to the launch, and additional details must be submitted within seven days after the launch. Roscosmos then records this data in the national registry and communicates it to the Ministry of Foreign Affairs, which in turn reports it to the UN Secretary-General for inclusion in the UN Register of Objects Launched into Outer Space.[52]

Liability and insurance

The fifth key element of a national space law, namely liability and insurance concerning space activities can be found most directly in the Liability Convention, which sets the stage for states to be held liable for damage caused by their space objects, encouraging the integration of insurance requirements and indemnification procedures within national space laws.[53] Under the Liability Convention, the liability of a launching state for damage caused by its space objects is detailed, encompassing damage on the Earth's surface, to aircraft in flight, or in outer space. It is a victim-oriented regime, with the financial implications of potential damages compelling states to create legal frameworks aimed at ensuring operators or owners of space objects to have adequate coverage for damage claims.[54]

The U.S. Commercial Space Launch Act is such an example, requiring commercial space operators to secure liability insurance that covers third party

[50] Lee 2006: 47.
[51] Russian Federation 1993.
[52] Tronchetti 2014: 30–31.
[53] Lyall–Larsen 2018: 104.
[54] Soucek 2016: 33.

claims for bodily injury, property damage and government property damage.[55] The Federal Aviation Administration (FAA) determines the necessary insurance amounts, based on a maximum probable loss assessment. Moreover, the Act's indemnification mechanism permits the U.S. Government to cover claims exceeding the insurance amount under certain conditions, showcasing a blend of private sector liability with public safety nets.[56]

In Japan, the Act on Launch and Control of Spacecraft of 2008 (ALCS) mandates that Japanese space operators obtain liability insurance to cover potential damages that could arise during space operations.[57] This insurance requirement ensures that operators are prepared to address any claims of damage caused by their space activities. The law specifies the minimum amount of insurance coverage required, which is determined based on the potential risks associated with each specific mission, taking into account the type of spacecraft, its mission profile and the potential for damage on Earth or in space.[58] The ALCS also establishes a framework for governmental indemnification, where the Japanese Government may step in to cover damages that exceed the insurance coverage, under certain conditions. The indemnification process is subject to stringent evaluation, ensuring that operators adhere to safety standards and regulatory compliance.[59]

Austria presents another example with its specific approach to space liability insurance. The Austrian Outer Space Act of 2011 sets a clear requirement for space operators, mandating a minimum insurance coverage of 60 million euros to address liability for damages caused by space operations.[60] This specific amount is among the highest set by national space laws. Research and educational space activities may qualify for exemption from insurance requirements if they serve public interests such as science, research, or education, have minimal

[55] United States 1984.
[56] Tronchetti 2014: 28–29.
[57] Japan 2008; Aoki 2009: 389.
[58] Aoki 2012: 126.
[59] Aoki 2012: 128.
[60] Austria 2011; Marboe 2012: 34.

associated risks, and the operator demonstrates sufficient financial capacity or provides appropriate security measures, with these conditions balanced against each other during evaluation.[61]

Safety

Transitioning to the aspect of safety considerations to include within a national space law, it becomes evident that ensuring the safe conduct of space activities is a fundamental concern, intricately connected to the broader framework of international space law. Safety measures are essential not only for the protection of human life and the environment but also for safeguarding assets in outer space and on Earth. These measures are crucial to prevent adverse impacts and harmful interference with other space operations.

National space laws are instrumental in implementing safety considerations, aligning with international obligations and reflecting the distinct national security and foreign policy interests of States. Conditions for authorising space activities under these national laws and regulations foster measures to ensure that operations are carried out in a manner that prioritises safety, minimises risks to persons, the environment, or property and prevents harmful interference with other space activities. This involves evaluating the proposed activities against safety and technical standards that are in line with international best practices, including for example the UN Space Debris Mitigation (SDM) Guidelines and Guidelines for the Long-term Sustainability of Outer Space Activities (LTS Guidelines).[62]

Slovenia's Space Activities Act of 2022 is one of many examples of a legislative framework that includes safety aspects, including measures to mitigate space debris in alignment with international standards. The Act specifically requires that space activities conducted under Slovenian jurisdiction adhere to internationally recognised safety and technology standards, including those related to the mitigation of space debris. Incorporating the UN SDM Guidelines, the

[61] Marboe 2012: 34.

[62] Soucek–Tapio 2019: 570–571.

Slovenian Space Activities Act mandates operators to implement measures aimed at reducing debris generation. Moreover, the Act's provisions underscore the necessity of conducting space activities without adverse effects to public health, the environment, or public safety. It stipulates that space activities should not only be safe from a technical perspective but also be considerate of their broader societal and environmental impact.[63]

The emphasis on safety in space activities, and the subsequent national implementation, reflects an endeavour to mitigate risks and promote the sustainable use of outer space. By establishing comprehensive authorisation conditions that prioritise safety, states contribute to fostering a responsible and sustainable space environment, ensuring the protection of human life, the environment and space assets for future generations. As the LTS Guidelines were only adopted in 2019, time will still have to tell how states implement these at a national level. While the explicit incorporation of these guidelines into national laws is emerging gradually, several countries have national space laws and regulations that reflect the principles embodied in the LTS Guidelines and a clear trend can be seen that more are prone to follow.

Transfer of ownership

The transfer of ownership or control of space objects in orbit presents unique challenges and considerations within the realm of national space law, especially regarding the continuity of supervision over non-governmental space activities, and the exercising of jurisdiction and control. The ability to maintain oversight is essential for upholding the principles of liability, safety and sustainability in outer space activities. When ownership of a satellite is transferred to a non-launching state, international responsibilities must be carefully managed. The registration and associated responsibilities, such as liability, jurisdiction and control, cannot be transferred to another state unless it is another launching state involved in the original launch. If the transfer of operation or ownership involves a non-launching

[63] Slovenia 2022.

state, the original state of registry, and *de facto* every original launching state, remains internationally responsible, and the original state of registry can be seen as a quasi-guarantor of obligations related to jurisdiction and control.[64] This state cannot fully absolve itself from its international responsibilities, maintaining a continuous link to ensure comprehensive accountability for the space object. This can be seen to prevent the occurrence of 'flag of convenience' scenarios in space operations, ensuring that the state causative for the launch remains liable for any damages or issues.[65]

Due to the above-mentioned reasons, some national laws require prior authorisation before a change of ownership can take place. Belgium's approach to the transfer of ownership or control of space objects is articulated in its Law on the Activities of Launching, Flight Operations, and Guidance of Space Objects of 2005. This legislation mandates that any transfer to a third party of authorised activities or real or personal rights, including guarantee rights, which transfers the effective control of the space object, may not be carried out without the Minister's prior authorisation. Specifically, the law stipulates that authorisation is required for transferring authorised activities or rights to a third party and states that when the transfer involves an operator not established in Belgium: the Minister may refuse authorisation if there is no specific agreement with the home state of the third party that indemnifies the Belgian State against any international liabilities or claims for damage.[66]

New Zealand's Outer Space and High-altitude Activities Act of 2017 represents another example of a national space law addressing the transfer of ownership or control of space objects. According to the Act, a licencee or permit holder may not transfer an interest in a licence or permit, or if the entity is a body corporate, undergo a change of control without the prior approval of the Minister.[67]

[64] Kerrest 2017: 79.
[65] Schmidt-Tedd et al. 2013: 256.
[66] Belgium 2005; Kerrest 2017: 80.
[67] New Zealand 2017.

Following possible internal approvals of transfers of ownership, states might wish to update the satellite's ownership details in their national register of space objects and report the change to the UN Register of Objects Launched into Outer Space.[68] While the Registration Convention primarily delineates the registration requirements for space objects at the time of launch, its provisions hint at broader responsibilities that extend to maintaining up-to-date records on space objects, including changes in ownership.[69] Although the Convention does not explicitly mandate updates on ownership changes in the national or UN Register, the underlying objective to promote transparency, enhance operational safety and foster international cooperation can be interpreted as supporting such updates. Article IV of the Convention suggests that launching States are expected to provide the Secretary-General of the UN with any additional information to preserve the accuracy of the data initially provided under Article II. This clause, while not directly mentioning ownership transfers, implies a responsibility to keep the register current, which could include updates on changes in ownership.[70]

TRENDS AND CHALLENGES

The legal landscape of outer space activities is evolving rapidly, with national space laws expanding beyond the foundational seven key elements to address a wider array of trends and challenges. The following sections highlight some of the many trends and challenges that are shaping the future of national space.

[68] Rodrigues–Memon 2017: 91.
[69] Di Pippo 2016: 367.
[70] Registration Convention 1976.

Legal aspects of Earth observation data

The advancement of Earth observation (EO) technologies has significantly enhanced the capability to monitor and analyse global phenomena from space, providing valuable insights into areas such as climate change, natural disasters, urban development and much more. This surge in EO capabilities has however introduced legal challenges, particularly concerning data privacy, sharing and security. National space laws are evolving to address these challenges, extending the scope of legal considerations well beyond the foundational seven key elements traditionally associated with national space legislation. One of the primary concerns is the management of the vast amounts of data generated by EO satellites. While open access to EO data can significantly benefit scientific research and public policy making, it also raises concerns about privacy and the potential misuse of sensitive information.[71] National laws are thus being developed to strike a balance between facilitating access to EO data for the advancement of knowledge and ensuring the protection of individual privacy and national security interests.[72] This can involve the implementation of regulations that govern the collection, processing, distribution and use of EO data.

Waivers and exceptions for educational and science programmes

Acknowledging space's immense educational and research potential, several states have implemented legislative measures designed to reduce regulatory burdens and provide financial incentives to academic institutions. These legal frameworks aim to lower the barriers to enter the space sector for educational and research entities, thus promoting innovation and the advancement of knowledge. Academic discourse also emphasises the importance of legal and policy frameworks in facilitating educational and scientific access to space. Studies and analyses in space policy literature often highlight the benefits

[71] Bohlmann–Soucek 2018: 189.
[72] Bohlmann–Soucek 2018: 190.

of regulatory measures that support academic institutions, advocating for continued legislative evolution to accommodate the growing role of educational entities in space activities. Countries around the globe are recognising the value of space for educational purposes and are implementing legal frameworks to support this.

Space traffic management

The increasing congestion of Earth's orbit, marked by a growing number of satellites and the persistent issue of space debris, underscores the growing debate around and collective efforts surrounding Space Traffic Management (STM). As the space environment becomes ever more crowded, the potential for collisions and the resultant creation of debris poses risks not only to current space operations but also to the long-term sustainability of space activities. Recognising these challenges, states are beginning to incorporate STM approaches into their national space laws and regulatory frameworks. This includes the implementation of best practices for satellite manoeuvres to avoid potential collisions, the establishment of standards for the safe disposal of satellites at the end of their operational lives, and the development of debris mitigation strategies to minimise the generation of space debris.[73]

Space resources

The burgeoning interest in the exploration, exploitation and utilisation of space resources has ignited a worldwide dialogue surrounding the legal, ethical and environmental implications of space resources. Environmental concerns are often at the forefront in these discussions, as the disruption of celestial bodies could have unforeseen consequences. The Outer Space Treaty stipulates that outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation,

[73] Antoni et al. 2020.

or by any other means.[74] However, the Treaty does not explicitly address the private extraction and ownership of space resources, which states are beginning to consider it on both international and national level. A handful of states have included space resource utilisation and/or exploitation into their national legislation, and a trend is noticeable with more to follow. The debate and inclusion into national legislation also pertains to claiming ownership of the resources and materials extracted from celestial bodies with a possible *raison d'être* being to encourage private entities to invest in space resource exploitation. Granting property rights would create clearer legal clarity for investment and commercial use, making it an economically safer and potentially profitable venture.[75] Established at the sixtieth session of the COPUOS LSC in 2021, the Working Group on Legal Aspects of Space Resource Activities has been mandated to gather relevant information on space resource activities, analyse the existing legal frameworks and assess the need for further international governance.[76] Ultimately, their findings could lead to the adoption of new resolutions or legal instruments by the UN General Assembly to guide future space resource exploration and utilisation.

Legal aspects of launch operations and spaceports

The surge in satellite launch demand, fuelled by advancements in space technology and the increasing use of satellites for communication, EO and scientific research has driven the development and expansion of launch infrastructure globally. This expansion has led to the establishment of new launch sites and spaceports, across various regions, each requiring a comprehensive legal and regulatory framework to govern their operations. The essence of these frameworks is to ensure the safety of launch activities, minimise environmental impacts, and maintain regulatory compliance, including adherence to international space law principles. National laws concerning launch operations and site

74 Outer Space Treaty 1967: Article II.
75 Tronchetti 2009: 194.
76 United Nations 2021: Annex III.

management incorporate licencing requirements for launch providers, detailed safety standards for both the launch process and the operation of launch vehicles, and rigorous environmental impact assessments for the development and operation of launch sites. The establishment of spaceports requires not only significant investment in infrastructure but also a clear regulatory framework that addresses a multitude of considerations, from airspace management to the potential for cross-border environmental impacts.

CONCLUSION

The exploration of outer space has transitioned from a domain dominated by a few spacefaring nations to a more diversified arena, thanks to technological advancements and the decreasing costs of space access. National space legislation now confronts the task of adapting to the nuances of evolving space activities. These laws and regulations are crucial for ensuring that space exploration and utilisation is conducted responsibly, safely and in compliance with international law, while also fostering the development of national space industries. The interplay between national space legislation and international space treaties is fundamental, as it ensures that global standards for space activities are maintained, while also accommodating the specific needs and interests of individual countries.

The expansion of national space laws beyond the foundational key elements – such as the scope of application, authorisation and supervision of non-governmental space activities, registration of space objects, liability and insurance, safety and transfer of ownership – highlights the evolving nature of space activities. Contemporary issues such as EO data privacy, educational and scientific access to space, space traffic management, space resources and the management of launch operations and spaceport activities represent a trend towards a broadening of the legal and regulatory focus. These areas underscore the growing complexities and the need for comprehensive legal frameworks that not only facilitate space exploration and utilisation but also

address environmental protection, promote safety and sustainability and ensure adherence to international cooperation norms.

The evolving landscape of outer space activities demands a continuous adaptation of national space laws. This adaptation is essential for navigating the challenges of a 'New Space Era' marked by increased participation, technological advancements and the expanding scope of human activity in space. By developing comprehensive legal frameworks, states can ensure that space remains a realm for peaceful, sustainable and safe exploration and use, safeguarding the interests of future generations.

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