

SPACE TOURISM CHALLENGES

*Małgorzata Polkowska**

ABSTRACT

Space is a new destination for tourism. Today tourists can travel the world using many different modes of transportation, including road, maritime, and air. People always want to discover new destinations. Human beings strive to break borders and go beyond - even to the stars. There are new technical and commercial challenges and innovations in reaching outer space. The new transportation business of today has already experienced many ups and downs, but definitely big projects, such as traveling to the Moon or Mars remain the purview of the perennial space powers. The Author considers what kind of challenges space tourism brings (in the commercialization era) and what kind of space governance and policy is needed to make this tourism efficient. Some comparisons referring to airspace and outer space aspects, such as managerial, organizational, and legal have been made. The basic analysis made in this article indicates that the commercial space industry seeks to be new space operators, provided that they operate in a safe and secure manner according to international rules and policies. Good strategic planning and management of space is the key.

Keywords: space tourism, space governance, space policy, aerospace challenges, ICAO, space business

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1. INTRODUCTION

Space transportation and space tourism issues are not new. Those subjects have been discussed at many international fora in the past. Some observers noticed that the private sector was already active in outer space in the Sixties. Space journeys seem to be a great adventure and a new era of space tourism is coming. The positive trend and the progress made in this domain suggest that space tourism could actually become a factor of space popularization¹. However, some observers are still very skeptical and see a lot of challenges such as the safety and security of passengers. Among others, space tourism is another niche segment of the aviation industry that seeks to give tourists the ability to become astronauts and experience space travel for recreational, leisure, or business purposes. Since space tourism is extremely expensive, it is a case of a very small segment of consumers that are able and willing to purchase a space experience².

Space tourism must be taken seriously. Space transportation of civilian passengers going to Space for pleasure and not as space technical mission members are already a reality. International companies offer already offer sub-orbital, orbital, and lunar trips and there is a long “waiting” list of volunteers waiting to fly to Space. As of today, over 100,000 people have signed up for space travel with private spacecraft companies³. While space tourism is currently an expensive mode of travel, experts predict this situation may change soon. Space flight safety may be much more assured within the next ten or fifteen years as space travel becomes more “routine” for the public. The ticket prices will decrease. This article examines some of the challenges associated with such a space transportation system including organizational, legal, safety, and security areas. Space transportation today serves not only as freight services to International Space Sta-

¹ Antonella Forganni, “The potential of space tourism for space popularisation: An opportunity for the EU Space Policy?,” *Space Policy* 41 (2017): 48–52.

² Isaac Levi Henderson and Wai Hong Kan Tsui, “The role of Niche Aviation Operations as Tourist Attractions, Air Transport: a tourism perspective,” 2019, <https://www.sciencedirect.com/topiic/socjal-science/space-tourism>.

³ Taiko Kawakami and Taichi Yamazaki, “What women need for space travel,” IAC-20-B3.2.9 (x56313), 71st International Astronautical Congress (IAC) – The CyberSpace Edition, 12–14 October 2020, 1–7.

tions or scientific missions but also more and more as touristic purposes. That is the reason why those challenges should be soon governed properly. The suborbital flight that allows people to discover “terra nulla” and to observe the Earth from a different perspective than aviation allows, seems to be better managed than a few years ago⁴.

This article is divided into a few sections. Section 1 includes the following topics: the beginnings of the space tourism issue, Section 2 commercialization of space, section 3- space tourism notion, section, 4- governance and policy of Air and Space (with subsections including Air and Space Traffic Management issue, or international air and space organizations). Sections 5 provide some legal challenges for space tourism. The last part of the article includes a discussion and conclusion. The subject of the article is innovative in that it has not been extensively covered in the current literature. The Author’s experience in her diplomacy work for the International Civil Aviation Organization as a Polish Council Representative (before her work for national carriers as a subject matter expert for the national carrier and the national regulator as an expert) and member of the ICAO subgroup of Suborbital flights helped in writing this article. Her presence and organization of the conferences and seminars referring to this topic allow this article to address current issues. This article incorporates the latest news and information referring to this subject from organizations such as the Institute of Air and Space, the United Nations treaties, and other regulatory bodies.

2. THE BEGINNINGS OF SPACE TOURISM

Space tourism has experienced some challenges in the past. The current approach to space tourism and the development of vehicles to access space are virtually all based on extensions of the current rocket launch

⁴ Małgorzata Polkowska, “Sub- orbital traffic: A new regulatory or non- regulatory discipline,” in *Harmonizing Regulatory and Antitrust Regimes for International Air Transport*, ed. Jan Walulik (New York: Routledge, 2018), 189–201.

vehicle and rocket plane development⁵. Seven people have paid to go to space to date, with American multimillionaire Dennis Tito becoming the first space tourist in 2001, flying to the International Space Station. ISS is a modular space station in low Earth orbit. It is a multinational collaborative project between five participating space agencies: NASA, United States, Roscosmos, Russia, JAXA, Japan, ESA, Europe, and CSA, Canada. The ISS serves as a microgravity and space environment research laboratory in which scientific experiments are conducted in astrobiology, astronomy, meteorology, physics, and other fields. It maintains an orbit with an average altitude of 400 kilometers. The ISS circles the Earth in roughly 93 minutes, completing 15.5 orbits per day. For a fee of \$20 million USD, Tito traveled to the ISS aboard a Soyuz capsule. During the period from 2001 to 2009, 7 space tourists made 8 space flights only. Orbital tourist flights were set to resume in 2015 but the one planned space tourism flight was postponed indefinitely and none have occurred since 2009⁶.

However, in 2019, several private companies in the U.S. began to take humans to space, most for the first time. This is being done by aerospace companies like Blue Origin and Virgin Galactic. Fast technological development of transportation space systems was noted. It seems that the regular transport of passengers and cargo from point A to point A at the Earth through airspace and outer space will be developing very fast. It should be remembered that there is also some criticism, which does not look at the use of space for short suborbital flights in a positive way⁷.

It seems that in the near future we will have a significant growth in the number of private entities ready to start operations as suborbital from the land. It will cause traffic in airspace. At present, there is a wide variety of launch infrastructure ex. in Russia, Switzerland, Great Britain or the U.S., which provide different safety rules for handling personnel or third parties on the ground. The space object returning to the ground may

⁵ Joseph Pelton, "The international challenges of regulation of commercial space flight," in *Space Safety Regulations and Standards*, eds. Joseph Pelton and Ram S. Jakhu (London: Elsevier, 2010), <https://doi.org/10.1016/B978-1-85617-752-8.10023-6>.

⁶ Marco Aliberti and Ksenia Lisityna, *Russia's Posture in Space, prospects for Europe* (New York: Springer, 2019), 63–64.

⁷ Vernon Nase, "Delimitation and the suborbital Passenger: time to prevarication," *Journal of Air Law and Commerce* 77, Issue 4 (2012): 747.

require priority landing. In addition, SpaceX (an aerospace manufacturer) announced in 2018 that they are planning on sending space tourists, on a free-return trajectory around the Moon on a Starship⁸.

As Space Watch Global from 4th of February 2021 stated, Elon Musk wants to launch tourists to space. SpaceX is targeting no earlier than the fourth quarter of this year for Falcon 9's launch of Inspiration4 – the world's first all-commercial astronaut mission to orbit – from historic Launch Complex 39A at NASA's Kennedy Space Center in Florida⁹.

3. THE SUBORBITAL FLIGHTS

Suborbital flight activity was born many years ago. On June 21, 2004, SpaceShipOne rose to an altitude of over 100 km, which is the imaginary border of Space. This is so-called "Karman lineage". Thus, SpaceShipOne made history as the first private spacecraft. A successful launch from White Knight in October 2004 and his second 7- day journey beyond 100 km started the new era of technology for short suborbital flights with passengers on board. The SpaceShipOne spacecraft took off from the White Knight carrier plane to an altitude of 15 km, after which both vehicles disconnected. The SpaceShipOne pilot turned on a rocket engine that allowed it to fly to a height of over 100 km in a suborbital flight (its speed is too low to enter orbit). After this maneuver was completed, the ship glided back to the airport. Since 2008, thousands of new passengers booked such flights. It's predicted that by 2030, such space tourism may encompass 5 million passengers. This may in turn lead to the creation of adequate infrastructure for tourists with hotels, and orbital sports clubs, or

⁸ Turystyka kosmiczna – jak wygląda przyszłość lotów w kosmos?, <https://www.speedtest.pl/wiadomosci/esej/turystyka-kosmiczna-jak-wyglada-przyszlosc-lotow-w-kosmos/>.

⁹ SpaceX will fly four tourists on Dragon into space, https://spacewatch.global/2021/02/spacex-will-fly-four-tourists-on-dragon-into-space/?utm_source=rss&utm_medium=rss&utm_campaign=spacex-will-fly-four-tourists-on-dragon-into-space&mc_cid=a-166dadaf10&mc_eid=UNIQID.

space mobility centers¹⁰. Some voices concern about the inevitable responsibility and liability issues, ownership, or the tourist's status. Sir Branson from Virgin Galactic predicted that a suborbital flight from Singapore to London will last 30 minutes. But of course, this may be cost-prohibitive. The next crucial issue is travel insurance both for the space object and for liability – the space object insurance and liability insurance (insurance “on third parties” and product liability). Such insurance is negotiated in every single case. Some requirements for space insurance are contained in the U.S. Commercial Space Launch Amendments Act from 2004¹¹.

4. COMMERCIALIZATION OF SPACE

In today's New Space era of commercialization, commercial use of space is more achievable today than ever before. Space community goals to achieve such norms (as in Aviation) to facilitate safe and responsible transportation empower space companies to invest in the new space tourism industry. Space policy is crucial here. Space powers such as the U.S. have space regulations that allow and stimulate private partners to use space and make profitable business based upon passenger transportation¹².

In the U.S. Commercial Space Launch Activities Act (USC Ch. 509) in Title 51—National and Commercial Space Programs in Subtitle V—Programs Targeting Commercial Opportunities as the opportunity of the Act is mentioned *inter alia*. “—Congress finds that—private applications of space technology have achieved a significant level of commercial

¹⁰ Taichi Yamazaki, Okabe Yo, and Koike Sota, “Space scooter”: space mobility systems used in space hotels and space stations, IAC-20-B3.7.17, 71st International Astronautical Congress (IAC) – The CyberSpace Edition, 12–14 October 2020, 1–7.

¹¹ Ram S. Jakhu, “Some legal aspects of commercial development of space,” the presentations at IASL McGill Macau Conference, 16–21 IV 2007, <https://uscode.house.gov/view.xhtml?path=/prelim@title51/subtitle5/chapter509&edition=prelim> U.S. Commercial Space Launch Activities Act (USC Ch. 509).

¹² Ram S. Jakhu and Yaw Otu M. Nyampong, “International regulation of emerging modes of space transportation,” in *Space Safety Regulations and Standards*, eds. Joseph Pelton and Ram S. Jakhu (London: Elsevier, 2010), 215–238, <https://doi.org/10.1016/B978-1-85617-752-8.10017-0>.

and economic activity and offer the potential for growth in the future, particularly in the United States. An example of such commercial collaboration is Project Artemis, which seeks to land the first woman and next man on the Moon by 2024, using innovative technologies to explore more of the lunar surface than before. NASA is collaborating with its commercial and international partners to establish sustainable exploration by the end of the decade. Those projects motivated new partners of NASA to cooperate and finally use space for transportation of passengers¹³.

The Ansari X Prize marked the beginning of a number of New Space activities that have, over the course of fewer than two decades, changed the basic feature of space activities from originally completely governmental to now increasingly private¹⁴.

In December 2018 Virgin Galactic conducted their first trip to Near-Space. Two pilots reached an altitude of over 82 kilometers. They planned to make additional test flights with the possibility of taking its first passengers – founder Richard Branson being first of all – to Space. Virgin Galactic already sold tickets at a cost between 200- 250 thousand USD¹⁵. Each of their flights is designed to carry six passengers, who will experience several minutes of weightlessness and be afforded incredible views of Earth as the space plane hops into space, before returning to a runway landing¹⁶.

Virgin isn't the only company hoping to reach Space. Blue Origin, with Amazon CEO Jeff Bezos at the helm, has been making waves with its reusable New Shepard rocket, which has flown to Space 10 times. Now the company is gearing up to launch humans for the first time.

¹³ Christopher Johnson, The Space Law Context of the Artemis Accords (Part 1), SpaceWatchGL Feature (27 May 2020), <https://spacewatch.global/2020/05/spacewatchgl-feature-the-space-law-context-of-the-artemis-accords-part-1/>.

¹⁴ Stephan Hobe, "A New Format for Space Law?," 2020 International Astronautical Congress (Cyberspace edition) Nandasiri Jasentulyana Highlight Lecture, 14–16 October 2020, 8–16.

¹⁵ Irene Klotz, Virgin Galactic Aims to Fly Space Tourists in 2018, CEO Says, Space.com - 28 April 2017, <https://www.sierracountynewmexico.info/press-coverage/virgin-galactic-aims-to-fly-space-tourists-in-2018-ceo-says/>.

¹⁶ Jeff Foust, "Origin plans to start selling tickets in 2019 for suborbital spaceflights," July 10, 2018, <https://spacenews.com/blue-origin-plans-to-start-selling-tickets-in-2019-for-suborbital-spaceflights/>.

Blue Origin plans to start selling tickets for its reusable rocket this year, with rumors suggesting they will charge a similar price to Virgin. Each launch, like Virgin, will also take six passengers to the edge of Space. They will be free to float around the rocket's capsule for several minutes, before returning to Earth via parachute. Another two private U.S. companies – SpaceX and Bo – are launching astronauts to orbit. SpaceX has now launched (November 2020) astronauts to orbit successfully, marking the company's first full-fledged operational mission with humans on board and beginning regularly scheduled commercial flights to the International Space Station. Moreover, SpaceX said that Starship would be able to fly from New York to Shanghai in 39 minutes, rather than the 15 hours it takes currently by airplane¹⁷.

Both firms are contracted by NASA to take astronauts to the ISS, but the companies also plan to fly their own astronauts, a key step towards making Space more accessible and opening up new doors for tourist flights. SpaceX has already begun talking about paid trips to the Moon as early as 2023. Space tourism has been taken much more seriously over the past several years. "Once we see humans flying on commercial rockets from the U.S., I think that space tourism will gain credibility, and that will be great for the industry overall"¹⁸. Space commercialization (use for commercial purposes such as space tourism) will definitely challenge regulators. Outer space is seen as "a high potential" for the private sector. Transport services of passengers and payloads with the innovative technology in use are a very promising business for many entities. One thing is certain: it will be crucial to construct and introduce such a new legal regime, which can support the private sector. Some observers noticed that new regulation for space tourism should be based on the Chicago Convention 1944 regulating air navigation¹⁹.

¹⁷ Michael Sheetz, "How SpaceX, Virgin Galactic, Blue Origin and others compete in the growing space tourism market," published 26 September 2020, <https://www.cnbc.com/2020/09/26/space-tourism-how-spacex-virgin-galactic-blue-origin-axiom-compete.html>, accessed October 22, 2020.

¹⁸ Ram S. Jakhu and Rajeev Bhattacharya, "Legal aspects of space tourism, The International Space Station and the Law," *International Institute of Space Law*, no. 45 (2002): 112–131.

¹⁹ Convention on International Civil Aviation, done at Chicago on the 7th December 1944, ICAO Doc. 7300.

5. NOTION OF SPACE TOURISM

Space tourism (under still development), can be defined as human space travel for recreational purposes. There are several different types of space tourism, including orbital, suborbital, and lunar space tourism. Work also continues towards developing suborbital space tourism vehicles²⁰.

Space tourism challenges regulatory issues related to the restrictions in the use of Air and Space, the definition of space objects and their legal status, the need to exchange traffic rights, and navigation rules in airspace²¹. There is an element of environmental risk that space tourism can incur, thus management of air and space navigation is a primary concern for the main challenge for those states who are engaged in the use of outer space (space-faring states). Besides, there is some concern regarding security issues, because outer space is widely used for military purposes. Some militarization and weaponization problems influence the commercial use of Space²².

6. SPACE AND AVIATION GOVERNANCE

Air transport, which is a developed industry today, paved the way for Space in the safety, security, and legal domains. This suggests that the space community should consider adopting rules developed by the Aviation international organizations and institutions responsible for such transport²³ or creating a new organization responsible for space. Others think that since space tourism is still an embryonic activity and has been gradually developing through private companies, existing international fora dedicated

²⁰ Marielle E. Dirks, "High hopes and low estimates: new space's rocky contractual road," *Journal of Space Law* 36, no. 1 (Spring/Summer 2010): 55.

²¹ Małgorzata Polkowska, "Sub- orbital traffic: A new regulatory or non- regulatory discipline," in *Harmonizing Regulatory and Antitrust Regimes for International Air Transport*, ed. Jan Walulik (New York: Routledge, 2018), 189–201.

²² Małgorzata Polkowska, *Prawo bezpieczeństwa kosmicznego* (Warsaw: Europrawo, 2018), 68.

²³ Armando A. Cocca, "Five centuries of contributions to a legal concept of peace," in *International Space – Miscellanea, liber amicorum honouring Andrzej Górbiel in his 65 Anniversary*, ed. Edward J. Pałyga (Koszalin: Bałtycka Wyższa Szkoła Humanistyczna, 1995), 41.

to the space theme, such as the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) are sufficient. Discussions within UNCOPUOS will inevitably address issues relating to the rights and obligations of space tourists, responsible companies, and states²⁴.

Space tourism needs good governance: policy and planning. If states want to develop a space tourist business and a new destination, safety and security rules must be provided. However, some observers noticed that the private space sector is more active when the governmental activities go down. Space and Aviation differ in strategy and planning. For example, in Aviation, there is a long list of regulations provided by the International Civil Aviation Organization (so-called “UN sister organization responsible for airspace”). Those rules are applied by IATA (International Aviation Transport Association) in cooperation with airlines worldwide (e.g., the establishment of international airports). All rules made by ICAO must be adhered to by all aviation organizations. Those also apply to the Air Transport Management (ATM) as a comprehensive and unified set of regulations for air traffic. Air Traffic Controllers governs air traffic and let airlines in reaching new destinations²⁵.

a) Space Traffic Management

Today, such regulations do not yet exist. Space Traffic Management (STM) rules are missing²⁶. It is unclear how or under what authority any entity could manage/control space traffic. It is more likely that an entity could help to facilitate the coordination between operators. The concept of STM is of intense interest today, primarily due to the increase in Space population and the ever-increasing quantity and complexity of Space actors (both states and companies). There are continual and substantive

²⁴ Jonathan C. P. Andrade, “Space tourism and Space Law: approach based on the law applicable to astronauts,” IAC-20,E7,1,16,x57317, 71st International Astronautical Congress (IAC) – The CyberSpace Edition, 12–14 October 2020, 1–4.

²⁵ “The rules of the Air”-Annex 2 to the Chicago Convention 1944 (ICAO Doc 7300).

²⁶ Ntorina Antoni, Christina Giannopapa, and Kai-Uwe Schrogl, “Legal and policy perspectives on Civil- Military Cooperation for the Establishment of Space Traffic Management,” *Space Policy Journal* 53 (2020): 1–9.

collision risks in both LEO (Low Earth Orbit) and GEO (Geostationary Orbit) orbit regimes. Moreover, “mitigation of this risk requires satellite operators, space object tracking entities and flight dynamicity to be ever vigilant and expend considerable resources and attention to ensure safe and efficient use of space for current and future generations”²⁷.

There are different phases of space flight which all need STM in order to ensure safety and orderly flow of traffic, both for spacecraft and aircraft. These phases include the launch, in orbit, and reentry phases. The question arising refers to the necessity of STM regulations? The interference of launching objects with air traffic is unavoidable. Spacecraft cannot reach outer space and return to Earth except through the same airspace that aircraft are using. Thus this physical interference of air flights and space flights needs to be handled by an effective traffic management system so that the safety of both aircraft and space objects is not jeopardized. There are high risks of a collision between operating and non-operating objects in orbit that would result in the creation of more space debris²⁸. There is a need to guarantee the safety and sustainability of Space while the space objects are in outer space. The most complete research conducted in regard to STM is reflected in a report called the Cosmic Study on Space Traffic Management of 2006, which was prepared by the International Academy of Astronautics (IAA) study group. This report defines STM as a 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. This study was updated and reissued in 2018 “Space Traffic Management - Towards a Roadmap for Implementation”. (ESPI report 2020²⁹).

²⁷ Daniel L. Oltrogge, “The “We” Approach to Space Traffic Management,” 2018 SpaceOps Conference, <https://arc.aiaa.org/doi/10.2514/6.2018-2668>.

²⁸ Christopher Newman, “Space law and the Space law Games: legal liability and mapping the future in orbit,” workshop on AMOS (Advanced Maui Optical and Space Surveillance Technologies) 15–18 September 2020.

²⁹ ESPI report 2020 “Towards a European Approach to Space Traffic Management! Reference source not found. Towards a European Approach to Space Traffic Management,” (ESPI 2020), 1.

b) Air Traffic Management

The ATM (Air Traffic Management) and STM challenges also include suborbital flights. Commercial aerospace operations are a reality (as UAS-Unmanned Aircraft Systems); delays in providing a global framework for them resulted in an extremely fragmented system. Due to the advanced technology, the concept of different types of space launch vehicles other than the traditional rocket launch system is being exploited which are likely to lead to significantly reduced launch costs. These concepts include launches from “mother” aircraft (Swiss Space System S3), high altitude launch station (Dark Sky), and “traditional operations” from airports (Rocketplane U.S.). If the suborbital aerospace industry is to grow, segregated operations cannot be the long-term solution. However, to integrate into the existing ATM system will require the development of a new regulatory, operational, and technical framework. This must ensure not only the safety of the suborbital passengers but also of the other users of the ATM system. No legal requirements exist for the management of space traffic.

There are no global regulations relating to traffic management between aircraft and space flights. In some national space legislation there exist some procedures ensuring (as far as practical) safe operations of space activities and separation assurance. However, they were not integrated into the Air Traffic Management System. There is no definition of suborbital operations. That is the reason why legal constraints do still exist. During a suborbital operation, the atmospheric flight phase accounts for much of the flight. For this reason, suborbital flight space objects are commonly considered to be “aircraft”, which is why the legal framework of ICAO applies to these vehicles. Besides, suborbital safety standards will be expected to have no negative impact on the safety of other aircraft. Passengers onboard the suborbital vehicle will increasingly demand higher standards of safety than is presently proved. Some private companies are already involved in space cabin personnel training (Space Flight Attendants -SFA) in the case to ensure the highest standard of passenger care, comfort, and welfare, in the name of safety and security during a flight³⁰ (Kirihaara, Taka-

³⁰ Yuko Kirihaara, Chieko Takahashi, and Taichi Yamazaki, “Creating a new business of Space Flight Attendant Service and SFA Academy,” AC-20-B3.2.10, 71st Inter-

hashi, Yamazaki, 2020). Target levels of safety will need to be established for suborbital operations. This raises the question of whether a separate suborbital flight traffic management system is needed.

Fast technological development of space transportation systems has been observed since the 2005 time frame. It seems that the regular transport of passengers and cargo from point A to point A at the Earth through airspace and outer space will be developing very fast. It should be remembered that there is also some criticism, which does not look at the use of Space for short suborbital flights in a positive way. In the near future, we may see significant growth in the number of private entities ready to start operations as suborbital from the land. It will cause traffic in the airspace. There is a risk that normal aircraft landing patterns may need to be suspended since a suborbital flight “go around”. New objects operate at higher altitudes than aircraft and are less maneuverable, so safety is a big risk. Probably there is a need to change the Annex 7 ICAO (Aircraft Nationality and Registration Marks)³¹, and the new definition of aircraft should be added. The changing nature of space objects, which seems to be similar to aircraft, may require some revision of the definition. For example, operations of White Knight Two are in accordance with the existing definition of aircraft, but SpaceShipTwo is not.

c) ICAO and UNOOSA initiatives

Many conferences and seminars refer to this subject. In May 2013 the Institute of Air and Space Law (IASL) at McGill and IAASS (The International Association for the Advancement of Space Safety) organized the conference about the perspectives of aerospace transport. The conference not only analyzed the current situation but assessed the legislative and operational challenges and suggested policy and mechanisms facilitating suborbital transport. During the conference, much was said about the need to standardize safety in space transport. It was stated also that the law should

national Astronautical Congress (IAC) – The Cyberspace Edition, 12–14 October 2020, 1–10.

³¹ Aircraft Nationality and Registration Marks- Annex 7 to the Chicago Convention 1944 (ICAO Doc. 1944).

enhance technology and business to be developed. One conclusion was undisputable- safety is still the priority for space passengers. Few issues were raised referring to the liability of space carrier- the question if there is a need to regulate it today or later is still open. Many space experts feel that this subject is not a priority. At the conference, the issue of transit of suborbital flights was also undertaken. As long as the space object is used for space transport and operates in the airspace of one state over the High Seas or in outer space, the transit rights are not necessary.

Transit rights are necessary when flying over one or a few countries in the process of exchanging traffic rights. Aerospace objects will transit above 60–100 km and they may be subject to a bilateral rights regime (and connected charges) needed for operations of commercial objects. As a result the necessary legislative actions should be undertaken by UNCOPUOS. One of the solutions could be bilateral for launching or return operations. It seems that ICAO (and ICAO Legal Committee) is also very interested in the Safety of Air Navigation (including suborbital flights) which is the priority of the Chicago Convention 1944, so close cooperation with UNOOSA is likely necessary. Under the ICAO auspices, the working space group was established, engaging in close cooperation with governments, UNOOSA and ICAO representatives, academia, space industry, and business.

ICAO and UNOOSA Aerospace Symposium in Vienna (29–31 August 2017) observed the need to speed up space legislation in the interest of the space community. The Space Learning Group established Terms of Reference which provided a common approach roadmap. The idea of creating the sub-legal group was also discussed. In the last non-published report after the symposium it was said *inter alia*, that series of ICAO/UNOOSA Aerospace Symposia brought aviation and space communities closer in mutual understanding and recognition of common areas of interest and concern for current and future aerospace activities.

Aviation safety and space sustainability were among the core areas of consideration in the series of aerospace symposia. Some challenges and hazards such as space weather, and space debris are key areas for further discussion. Other emerging areas included data gathering, analysis and protection, spectrum protection, and harmful interference between radio-communication services, critical ground infrastructures, and the pro-

tection of space systems and aviation systems. Cybersecurity poses a serious challenge that requires further collaboration and dialogue among the aviation, space, and telecommunication sectors to be further explored³². There is an increasingly high demand for the launching of payloads. The emerging commercial space transportation sector is evolving rapidly and given different international legal regimes for aviation and space flight and space activities, demand better coordination at the intergovernmental level. ICAO, UNCOPUOS, ITU (International Telecommunication Union), and IMO (International Maritime Organization) will play a significant role here. EASA- (European Aviation Safety Agency) responsible for air safety in Europe became recently also interested in emerging space issues³³.

At the ICAO/UNOOSA conference in Vienna in 2017, some delegates raised the issue of complex activities and legal regimes in Near-Space which needs to be a further study in the case to eliminate the uncertainties, which may restrict the industry. Harmonization of certain requirements as licensing, authorization, supervision of orbital and suborbital activities may help the governments in establishing their internal regulations (during the symposium few representatives of space agencies presented their legislation as an example: France- CNES, Germany- DLR, UK- latest law from 2017 entering into force in March 2018, the U.S.- FAA). It is the reason, why international policies and guidelines are welcome. The report also stated that national authorities are working closely with the industry, the private sector, and non-governmental organizations or academia to define the best requirements for stability, consistency, and predictability in developing and applying a national regulatory framework for commercial space transportation. The representatives of space business underline the need for legislation stability, which makes the business more stable and predictable.

³² Nayef Al Rodhan, Cyber security and space security. What are the challenges at the junction of cybersecurity and space security?, May 2020, <https://www.thespacereview.com/article/3950/1>.

³³ Jean Marciacq, Felipe Tomasello, Erdelyi Zsuzsanna, and Gerhard Michael, "Establishing a regulatory framework for the development and operations of sub-orbital and orbital aircraft (SoA) in the European Union," in *Regulation of emerging modes of aerospace transportation*, eds. Ram. S. Jakhu and David Kuan-Wei Chen (Montreal: McGill, 2014), 261–306.

The space sector is growing with new actors and technological advancement in the space field accelerating. The representatives of the Civil Air Navigation Services Organization- CANSO (which brings the world's air navigation service providers, leading industry innovators, and air traffic management specialists together), pointed out that there is a need to further explore the possible future establishment of an international space traffic management system that is interoperable with the global air traffic management system and supporting infrastructure, into which aerospace activities must be safely integrated. EUROCONTROL (European Organization for the Safety of Air Navigation) representatives agreed on that as well.

The report also indicated that the development of international provisions for commercial space transportation was seen as one element requiring further discussion. There is a need to take into account emerging aerospace activities, including human space transportation, the different nature of orbital and suborbital environments, and the inherently different requirements under International Air Law and establish mandates of the intergovernmental bodies involved. There is also a need to clarify the scope of aerospace activities that should be studied, including the elaboration of problem statements, conducting gap analysis, and the determination of the work program. Performance-based standards that consider associated risks need to be considered to allow for the flexibility of future technological development, increase predictability and transparency, and enhanced implementation.

Suborbital vehicles share airspace with aircraft and spacecraft, and it is, therefore, important to consider the notion of "integrity" while regulating the traffic management aspects of different types of flying vehicles to prevent collisions and ensure the optimum use of airspace. The best scenario could be the development of an integrated traffic management system that would render services for all types of aircraft, spacecraft, and suborbital vehicles at all altitudes. However, bearing in mind all the legal hurdles in the existing international legal framework of air and space, as well as the technical complications, this might be too optimistic, at least in the short term.

ICAO established its Learning group of Suborbital flights with international experts. There is hope that they can achieve the most in legisla-

tion (step by step) having much experience with ATM (ICAO technical annexes). The group cooperates with UNOOSA (United Nations Office for Outer Space Affairs) discussed the proposal of creating a new technical annex or amending existing ones³⁴. The group's task shall be to examine questions relating to civil space transport in order to better understand the future needs of industry and, in particular, to start to plan safe, effective, and routine activities in an unoccupied space. The aim of the learning group is to check the relevant regulations and recommendations prepared by the Member States and develop a work program for consideration by the ICAO's Air Navigation Commission, including the space theme within GANP and GASP (Global Air Navigation and Global Aviation Safety Plans). The group is to inform ICAO of important matters relating to suborbital flights, collecting, and sharing best practices on these activities in the coming years, and determine whether the space component should be included in future plans for navigation and safety. ICAO encourages the participation of the Commission, in close cooperation with the industry and international organizations, shall carry out questionnaires on transport issues, initiates discussions on the use of airports/spaceports, in order to facilitate suborbital flight operations, space delimitation and aircrafts space and air delimitation, integration of the navigation systems, responsibility for space activities or the necessity of the creation of a new annex on space³⁵.

³⁴ Thomas Cheney and Lauren Napier, "Policy Memorandum: Air Versus Space, Policy Analysis: Air versus Space, Where do Suborbital Flights Fit into International Regulation?," *Journal of Science Policy & Governance JSPG* 7, Issue 1 (August 2015): 1–13.

³⁵ Paul S. Dempsey and Maria Manoli, "Suborbital flights and the delimitation of air space vis a vis outer space: functionalism, spatialism and state sovereignty," Submission to the United Nations Office of Outer Space Affairs By The Space Safety Law & Regulation Committee of the International Association for the Advancement of Space Safety, Reference: OOSA/2017/19 12 September 2017 CU 2017/351(D)/OOSA/CPLA submitted to Office for Outer Space Affairs, United Nations Office at Vienna, P.O. Box 500, 1400 Vienna, Austria. (submissions@unoosa.org) December 9, 2017.

d) ICAO legislation about Space

ICAO has extensive legislation (technical annexes to the Chicago Convention) and the implementation system. These annexes could be amended by adding specific provisions on space issues (e.g. spacecraft, licensing regulation), the Chicago Convention could be updated by establishing ICAO's jurisdiction in space. Due to possible risk potential in the event of a collision between a spacecraft and an aircraft, the amendment of the rules shall consider prevention, i.e. as soon as possible. This applies in particular to suborbital vehicles, which will soon be operating commercial flights. When establishing new SARP's (standards and recommended practices) and complementing existing SARP's, ICAO shall take into account the problems and areas that exist today (e.g. security or environmental protection) rather than in times of need the creation of the Chicago Convention in 1944, hence space should not be a topic foreign to ICAO³⁶.

One of the working documents for the 175th Session of the ICAO Council of 30 March 2005 presented by the ICAO Secretary-General concerned space matters and was under consideration by the 36 Council members. The Council, due to the increasing importance of commercial transport of passengers has been exchanging views, whether such flights fall within the scope of the 1944 Chicago Convention and are subject to the ICAO regulatory regime. The Council noted that UNCOPUOS had considered possible legal scenarios, with regard to suborbital vehicles, in order not to duplicate tasks. The Council decided to follow the work of the subcommittee and to be kept informed of the outcome of its work. ICAO has participated in several meetings of the subcommittee to see the scope of activities that ICAO could potentially become involved with³⁷.

ICAO Resolution A29-11 provides that ICAO will continue to be responsible for determining the position of civil aircraft in all matters

³⁶ Ram S. Jakhu, Tomasso Scobba, and Paul S. Dempsey, *The need for an Integrated Regulatory Regime for Aviation and Space, ICAO for Space?* (Vienna: Springer, 2011), 127–130.

³⁷ Nancy Graham, "Message from the ICAO," in *Regulation of emerging modes of aerospace transportation*, eds. Ram S. Jakhu and David Kuan-Wei Chen (Montreal: McGill, 2014), 3.

relating to space³⁸. ICAO itself refers at a long distance to the immediate necessity of the regulation of space. This refers to the legislative experience of UNCOPUOS and declares that it will cooperate with them. ICAO notes the rapid development of space technologies and new trends (commercialization of space activities, more and more convergence points with civil aviation, e.g. in the area of aircraft and space object contracts). ICAO is not enthusiastic about the creation of a new annex and believes that it is necessary first to get to know and understand the existing problems, and only then create with the help of a study group guidance material. In June 2014 ICAO has sent a State Letter to Member States (AN 1/64–14/41) requesting information on the activities of the space sector in their territories and forthcoming plans on this subject. According to ICAO, it is too early to develop SARP's; at present, there is not enough understanding of the subject to integrate it into the work cycle of the organization. Raising awareness among countries is essential and further research is therefore required.

Aeronautical and space issues have much in common from a safety perspective. Underline here the international dimension of space accidents, involving: passengers, astronauts, or private crew and passengers. ICAO's activities would be based on four pillars, i.e. policy and regulation, safety oversight, monitoring (inspection, search and rescue) and independent accident investigation (to prevent and determine the causes). The current ICAO structure could be expanded to include a new compartment (Space Navigation Bureau) subordinate to the ICAO Secretary-General and Deputy Directors. It would be responsible for issues relating to launch (site related certificates), accident prevention, traffic management (Space Traffic Management), maritime safety oversight, and certification and space medicine (including crew and passenger medical examinations). Besides, the new section would be under the direct authority of the ICAO Secretary and would be independent of the accident office and the Space Safety Oversight Audit.

The idea to change the scope of ICAO's activities was based on the fact that UNCOPUOS was not been able to amend existing space conven-

³⁸ Use of space technology in the field of air navigation, ICAO Assembly resolutions, Doc 9600, A 29-RES:70.

tions for many years. It was therefore considered that ICAO's competence should now be extended, while clarifying the questions that are still open, such as those concerning the differences between space or the classification of space objects. ICAO could also develop a certification procedure security for commercial space service providers. Operators call on the ICAO to adopt the task of harmonizing air and space law in the following years³⁹.

It is important here to harmonize the rules within SARP's (as provided for in Articles 37 and 38 of the Chicago Convention). Since, under the ICAO Convention, it is responsible for emissions from air navigation should have an impact on air traffic and the associated space movement. Therefore, it is proposed that the Council of ICAO broadens the organization's scope of activities and amend the annexes (so that ICAO's oversight also covers e.g. suborbital and air traffic-related suborbital flights). Another solution would be to adopt a new treaty. Such a treaty, realized through a small number of ratifications, could address the issues of greatest concern.

The existing ICAO Air Navigation Bureau would therefore extend the scope of its own activities. A separate office would solve the problems at the interface between air and space navigation. The sooner these matters are settled, the sooner any collision between them could be avoided. At present there are no common standards for aerospace operations, there is no vision for the future or hope for new regulations. It is certain that space objects cross the air border at the entry into space. It is often an international space because many of the launches take place from areas located close to the oceans (for safety purposes). ICAO currently has regulations in place - ATM's for aircraft over the High Seas. Object classification should be based on functional approaches.

Another way to address space security issues is to create a new organization, following the example of EASA in Europe. Such an organization would be involved in, inter alia, certification.

³⁹ Paul S. Dempsey and Michael Mineiro, "The ICAO's legal authority to regulate aerospace vehicles," in *Introduction to space safety regulations and standards*, eds. Joseph N. Pelton and Ram S. Jakhu (Nidjihof: Routledge, 2010), 250–252.

7. LEGAL CHALLENGES

Space tourism also raises questions related to liability (civil or criminal). The 1968 UN Astronauts Rescue Agreement⁴⁰ addresses only astronauts and personnel, not passengers. Some observers recommend a broader definition in this regard. The legal regime of astronauts is extremely simple and incompatible with the risks they are exposed to perform activities of interest to humanity. Space tourists, who cannot be considered “personnel”, cannot apply the current rules of Space Law. Finally, it is essential to create specific international standards, which will be regulated by internal standards. The legal regime applicable to astronauts is insufficient. There are predictions that they are “sent from humanity”, however, this expression does not have, by far, the legal load that it suggests it has. States recognize the importance of astronauts, due to the risks they are exposed to develop activities of interest to them and to humanity, but the list of rights is negligible⁴¹.

In the U.S. 2004 Act, there is also the definition of “crew” and “participants of the space flight”. Very similar provisions are included in the ISS (International Space Station) agreement. The status of “tourists” in space is different from “astronauts” in international treaties. According to Art V of OST, astronauts are envoys of mankind in outer space. States shall render to them all possible assistance in the event of accident, distress, or emergency landing on the territory of another State Party or on the High Seas. When astronauts make such a landing, they shall be safely and promptly returned to the State of registry of their space vehicle.

In carrying on activities in outer space and on celestial bodies, the astronauts of one State Party shall render all possible assistance to the astronauts of other States Parties. States Parties to the Treaty shall immediately inform the other States Parties to the Treaty or the Secretary-General of the United Nations of any phenomena they discover in outer space,

⁴⁰ Resolution adopted by the General Assembly 2345 (XXII). Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (1968).

⁴¹ Jonathan C.P. Andrade. “Space tourism and Space Law: approach based on the law applicable to astronauts,” IAC-20,E7,1,16,x57317, 71st International Astronautical Congress (IAC) – The CyberSpace Edition, 12–14 October 2020, 1–4.

including the Moon and other celestial bodies, which could constitute a danger to the life or health of astronauts. Besides, the space journey demands from the traveling public to be well prepared for such a flight. Medical examination and the right psychophysical conditions are necessary to make space travel. So the question of proper preparation and planning such destinations is crucial. Having in mind the tourist branch in space there is also a couple of questions about the ownership rights at the planets or asteroids. There is some media news about Moon tourists based on researches made by astronauts about living there by human beings (one of the arguments is the availability of water). There are some questions about the state's right to hotels. Thus, there is a necessity to update existing and binding Space Treaties to facilitate such new touristic destinations. Among many observers, the international treaties should not regulate too much, but the regulations should be feasible to implement by different local regimes. National law should supplement the international rules. That is the reason why good management of space national policy plays an important role⁴².

There are some obstacles to the practical use of existing Space treaties that need new international governance. The status of space travel should be determined as well. The space journey may demand transits through the borders of several states, which are sovereign according to the Chicago Convention 1944⁴³. As stated before, there is no border between Air and Space. The national regime may impose restrictions on flights through the airspace. There is no clear and accepted definition of innocent passage of potential suborbital flight as well, which describes the conditions of space flight of the single ship through the air space of different states. Thus the space journey will demand a license from all states whose airspace will be crossed. Since space tourism will be mostly a commercial activity, some states may not agree to issue such a license or may wish to introduce legal or financial barriers in obtaining such. For this reason, states should make

⁴² Michel Bourély, "Quelques réflexions au sujet des législations spatiales nationales," *Annals of Air and Space Law* XVI (AASL 1991): 266.

⁴³ Michel Chatzipanagiotis, "The impact of liability rules on the development of private commercial human spaceflight," in *Proceedings of the International Institute of Space Law: 54th Colloquium on the Law of Outer Space* (Leiden: International Institute of Space Law, 2011), 52–56.

bilateral or multilateral agreements regulating these sensitivities. The situation is further complicated by issues regarding patents, contracts with manufacturers, and others. For future space tourism, the law must be clear and transparent. There is also the need to support this kind of space activity by governments to facilitate those activities by the private sectors.

Due to commercialization, there is a special need to address such legal issues as “spaceports”, “launches”, “radiation”, “space debris” and “radio spectrum frequencies”. As it was already stated, the use of air and space law in the case of suborbital flights is still unclear. Suborbital operations issues are quite complex and require cooperation with governments, space agencies, and space entities at the market level⁴⁴. It is not clear, which safety and security provisions must be followed. Pragmatic solutions may be used. As an example, U.S. law permits passengers to be transported on a suborbital flight at their own risk. The carrier should inform the passengers about travel risks and insurance. In space, passenger rights should also be protected. Some authors very openly call for creating the international provisions of civil liability in the name of development of commercial activities in space. The rest think that national law is sufficient in this matter⁴⁵.

Suborbital passengers and their safety and security have not yet been regulated. “Suborbital flights” have only recently come to be defined in the framework of national legislation, but in the U.S. they are covered by the law from 2004 about commercial launches. Some authors tried to form such a definition⁴⁶.

Suborbital flights and space tourism demand necessary steps to be taken. One of them is a consensus definition of the demarcation between airspace and outer space. Even though the UNCOPUOS included “the

⁴⁴ George C. Nield, “A new way to look at things,” in *Regulation of emerging modes of aero-space transportation*, eds. Ram S. Jakhu and David Kuan-Wei Chen (Montreal: McGill, 2014), 21.

⁴⁵ Hamid Kazemi, Hadi Mahmoudi, and Ali Akbar Golroo, “Towards a new international space Liability regime alongside the Liability Convention 1971,” in *Proceedings of the International Institute of Space Law: 54th Colloquium on the Law of Outer Space* (Leiden: International Institute of Space Law, 2011), 272–273.

⁴⁶ Stephan Hobe, Gérardine Meishan Goh, and Julia Neumann, “Space Tourism activities – emerging challenges to air and space law?,” *Journal of Space Law* 33, no. 2 (2007): 359–373.

definition and delimitation of outer space” on its first agenda six decades ago and has been deliberating on the issue ever since, these questions have now become all the more important with the proliferation of commercial space activities and accelerated development of suborbital flying machines. The ensuing academic debate between two approaches— Functionalism and Spatialism— have found their way into divergent opinions of States as expressed in international fora, national legislation, and aviation treaties.

After examining the merits and demerits of these approaches, the Institute of Air and Space Law with its partners (IAASS- International Association for the Advancement of Space Safety) made a legal proposal of establishing an intermediate region (18–160 km) between airspace and outer space with a mixed legal regime, instead of an abrupt demarcation line (based on Functionalist or Spatialist approaches) to separate the two regions⁴⁷. Near-Space is an innovative and possible solution for the issue of delimitation of air space and outer space and the proposed draft Convention can be an important start of a discussion⁴⁸. Thus, a specific legal regime for Near-Space is needed. This legal regime should center around limited sovereignty but with full jurisdiction of the underlying State. The new legal regime would hope to illuminate how the conscious economic exploitation of Near-Space can lead to greater sharing of economic and environmental benefits with the public at large. The new idea presented by the Institute used the precedent of the exclusive economic zone (EEZ) and suggests a new categorization of the Near-Space as the exclusive utilization space (EUS) and a set of rules to manage its utilization. Uniformity of law may improve the market’s interest in investment in space transportation, and the insurance industry’s ability to assess and price risk. Delineation of

⁴⁷ Dempsey Paul S. and Maria Manoli, “Suborbital flights and the delimitation of air space vis a vis outer space: functionalism, spatialism and state sovereignty,” Submission to the United Nations Office of Outer Space Affairs By The Space Safety Law & Regulation Committee of the International Association for the Advancement of Space Safety Reference: OOSA/2017/19 12 September 2017 CU 2017/351(D)/OOSA/CPLA submitted to Office for Outer Space Affairs, United Nations Office at Vienna, P.O. Box 500, 1400 Vienna, Austria. (submissions@unoosa.org) December 9, 2017.

⁴⁸ Tomasso Scobba and Mini Gupta, “Near Space Activities - The Search for a New Legal Regime,” 71st International Astronautical Congress (IAC) – The CyberSpace Edition, 12–14 October 2020, IAC-20,E7,VP,13,x59461, 1–8.

which legal regime applies – in air space, near space, and outer space - will clarify rights and obligations, and enhance the margin of safety for aircraft, spacecraft, and aerospace vehicles operating in all three zones⁴⁹.

During reentry, the object will transit both through outer space and airspace and may be covered by two different international legal regimes. The same object may be defined as a space object while journeying through outer space. The term “space object” is not defined in international conventions, but from a practical point of view, a space object must be equipped with all components that facilitate its launch. There are some questions referring to the registration of space objects and notification to the UNOOSA (United Nations Office for Outer Space Affairs) - if those provisions can apply to suborbital flight operations as well? There are also a couple of questions referring to state responsibility and liability for space operations. This subject is crucial in the context of environmental protection of outer space (space debris). Aviation and space law are covered by two different legal regimes (Chicago Convention 1944 and Outer Space Treaty 1967⁵⁰), stating about the sovereignty of the states in their airspace and the non-appropriation principle. There is still no certainty about the border between airspace and outer space. The Karman Line (100 km above the Earth) can be such a limit, but it has never been used as a provision of a binding Treaty. Some space-faring nations don't treat this lack of regulation as a problem. The limits can be more political issues than practical. There is still no formal decision on this issue at UNCOPUOS (The Committee on the Peaceful Uses of Outer Space) level.⁵¹

The use of air and space law in the case of suborbital flights still is unclear. There is no certainty in which safety and security provisions must be followed. Pragmatic solutions may be used (e.g., U.S. law permits the transportation of space tourists at their own risk, as long as the space tourism carrier informs them about the risks and relevant insurance issues).

⁴⁹ Liu Hao and Fabio Tronchetti, “Regulating Near-Space Activities: Using the Precedent of the Exclusive Economic Zone as a Model,” *Ocean Development & International Law* 50 (2–3) (2019): 1–27, <https://doi.org/10.1080/00908320.2018.1548452>.

⁵⁰ UN Outer Space Treaty 1967, UN ST/SPACE/11.

⁵¹ Neto Bittencourt and Olavo de Oliveira, *Defining the Limits of Outer Space for Regulatory Purposes* (Cham-Heidelberg-New York-Dordrecht-London: Springer, 2015), 31.

8. CONCLUSION

Space is a new destination that is open to all mankind. According to space treaties, outer space should be used in the interest of all nations on equal and fair conditions. Even though the cost of the space tourism experience today is very high, it is expected to be lower soon due to growing technology and innovations. Fast commercialization and opening new space markets to different international entities should be accomplished in concert with the implementation of professional management of space activities. Space tourism must be managed properly by international space governance, under the auspices of such entities as UNCOPUOS.

States themselves should make their space policies in a manner that fosters the commercial use of outer space. The international space community should support those initiatives to the benefit of all users. In the end, this will help the operators make good strategic plans and find interesting new challenging destinations for more and more demanding clients. Such rules must be implemented and followed by states for common safety and security. Operational risks must be lowered as much as possible. Insurance protection should be involved. All those rules are necessary to make this new kind of tourism profitable and efficient.

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