On increasing commercial space operations and global integrated airspace safety governance

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ON INCREASING COMMERCIAL SPACE OPERATIONS AND GLOBAL INTEGRATED AIRSPACE SAFETY GOVERNANCE

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ABSTRACT

Advanced space technology has brought what we long thought were rather quite remote issues to our daily lives. The experience of the coronavirus (Covid-19) pandemic also confirmed that communication technology is more critical than ever, with space commerce playing a crucial role in our collective future. An increasing number of commercial space companies, national research institutions and developers of advanced spacecraft technology have introduced reusable spacecraft and decreased the cost of space launches, giving way to a booming space industry. In turn, space is becoming increasingly crowded, with more traffic than ever and debris issues that impact civil aviation safety as space operations are integrated into national airspace: the "integrated airspace."

The legal regimes for air and space law are rooted in times when advanced air and space technology and operations did not exist. There is a discernible lack of legal certainty around determining which regime should apply in the integrated airspace: air law or space law? Are existing legal regimes for air and space activities compatible with air and space market developments? Or should a new global legal regime be established to address integrated airspace safety, security and traffic management standards?

This article explores the growing interaction between air and space operations and the impact of increasing commercial space activities on civil aviation safety in integrated airspace. The article

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argues that the current international regulatory framework for those space commercial activities that overlap with aviation operations is insufficient and posits that an integrated governance system with harmonized air and space operations standards is becoming increasingly necessary. Finally, the article discusses the prospect of establishing a collaborative regulatory safety management system that would serve air and space industries in balance for integrated air and space activities within the auspices of the International Civil Aviation Organization (ICAO).

I. INTRODUCTION

The global development of air transport led by market liberalization and privatization has positively affected space commerce activities.[1] In 1997, as part of the General Agreement on Trade Services (GATS) administered by the World Trade Organization (WTO), 69 countries signed an agreement to provide market access to their basic telecommunication sector.[2] Since then, the space economy has been growing.[3] Among the drivers for the growth are climate change, security and telecoms.[4] Telecommunications have become the foundation of the digital economy.[5] The WTO reports more than US$1.6 trillion in revenue of the sector, 65% of which comes from mobile services.[6]

Furthermore, in 2020-2021 during the Covid-19 pandemic, telecommunications became major service providers for many sectors with the growth in demand for online activity.[7] As a result, satellite

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[1] Laura B. Sherman, *World Trade Organization: Agreement on Telecommunications Services (Fourth Protocol to General Agreement on Trade in Services)*, 36 INT'L LEGAL MATERIALS 354 (1997). *See generally* David Gillen, *The Evolution of Airport Ownership and Governance,* 17 J. AIR TRANSP. MGMT. 3 (2017).

[2] *Report of the Group on Basic Telecommunications*, WORLD TRADE ORG. (Feb. 15, 1997), https://www.wto.org/english/news_e/pres97_e/finalrep.htm.

[3] *Id*.

[4] *5 Key Themes in the New Space Economy,* MORGAN STANLEY (May 19, 2022), https://www.morganstanley.com/ideas/space-economy-investment-themes.

[5] Marta Poblet, *Affordable Telecommunications: A New Digital Economy is Calling*, 1 AUS. J. OF TELECOMM. & DIGITAL ECON. art. 12, 12.1 (2013).

[6] *Telecommunication Services*, WORLD TRADE ORG., https://www.wto.org/english/tratop_e/serv_e/telecom_e/telecom_e.htm#:~:text=Extensive%20trading%20is%20undertaken%20via%20commercial%20presence%20by,which%2065%20per%20cent%20is%20from%20mobile%20services (last visited May 19, 2023).

[7] *Id*.

technology became an essential part of contemporary daily life globally.[8] The *Space Economy Initiative Insights Report 2021* estimates the growth of the space economy by US$447 billion in 2020.[9] The *Space Report of 2022* indicates that the global space economy reached a value of US$469 billion in 2021.[10] The commercial space sector reached 6.4 revenue growth since 2020.[11] The report also indicates that in the first six months of 2022, 1,022 spacecraft were placed into orbit.[12]

Space technology development provides new services for other sectors such as energy, transport, maritime, aviation, meteorology and more. As such, growth in the space sector also leads to the advancement of other sectors.[13]

However, the core treaty establishing principles governing outer space—the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies[14] (Outer Space Treaty)—was established in a different era when space activities were very limited.[15] According to the Outer Space Treaty, States are responsible for any national space activities in outer space, whether conducted by State agencies or non-governmental entities (private actors).[16] As a result, many States and private commercial companies operate space activities in outer space under many different national regulations. In this context, State self-interest behavior towards space activities and the rise of commercially motivated private space

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[8] *Space Economy Initiative Insights Report 2021*, UNITED NATIONS OFF. FOR OUTER SPACE AFFS. (Jan. 2022), https://www.unoosa.org/documents/pdf/Space%20Economy/2021_Space_Economy_Report_-_Africa_In_Focus.pdf.

[9] *Id*.

[10] *Space Foundation Releases the Space Report Q2 2022 Showing Growth of Global Space Economy*, SPACE FOUND. (July 27, 2022), https://www.spacefoundation.org/2022/07/27/the-space-report-2022-q2/.

[11] *Id*.

[12] *Id*.

[13] *What is the Space Economy?,* EUR. SPACE AGENCY (Oct. 2019), https://space-economy.esa.int/article/33/what-is-the-space-economy.

[14] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

[15] CHRISTIAN BRUNNER & ALEXANDER SOUCEK, OUTER SPACE IN SOCIETY 76-84 (2011).

[16] Outer Space Treaty, *supra* note 14, art. VI.

companies increased the frequency of commercial space launches, creating at first glance potential hazards for aviation safety.[17]

Considering the growth of commercial space operations by States and private companies and new types of space vehicles and operations invented through advanced technology, the existing legal framework can be seen as inadequate. Furthermore, the lack of a regulatory governance system for integrated airspace with harmonized standards creates challenges for future sustainable space and air operations.[18] Many issues require clarity in this overlapping airspace where the Convention on International Civil Aviation[19] (Chicago Convention) applies, and ICAO has the competency to set standards, including, among others, as airworthiness, certification, traffic rights, liability and licensing.[20] Since each group of space operators carry on part of their operations in civil airspace, these operators need to be addressed as airspace users. Therefore, the airspace governance system must develop a strategy for all users and their competing interests.

II. INCREASING COMMERCIAL SPACE ACTIVITIES

Space commerce and the production of commercial space activities significantly influence people's lives, especially within the communications field. As a result, the space industry has embraced the "era of access and an opportunity" including new actors and possibilities beyond traditional space operations.[21]

Nowadays, commercial space activities make up the most significant part of the space economy.[22] The Space Report 2021

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[17] ICAO Working Paper, *Impact of Commercial Space Operation on Civil Aviation*, ICAO 13TH AIR NAVIGATION CONF. (2018) https://www.icao.int/Meetings/anconf13/Documents/WP/wp_299_en.pdf [hereinafter ICAO WP 299].

[18] Gilles Doucet, *Outer Space SARPs: A Step Towards Harmonisation of National Regulations for the Enhancement of Sustainability of the Space Environment*, 61 PROC. INT'L INST. SPACE L. 867, 868 (2018).

[19] Chicago Convention on International Civil Aviation, Dec. 7, 1944, 15 U.N.T.S. 295 [hereinafter Chicago Convention].

[20] *See* RAM S JAKHU, KUAN-WEI CHEN, REGULATION OF EMERGING MODES OF AEROSPACE TRANSPORTATION xi (2014), https://www.mcgill.ca/iasl/files/iasl/0.12_regulation_of_emerging_modes_of_aerospace_transportation_front_pages_final_17jun14.pdf.

[21] Tom Roeder, *State of Space 2022: Industry Enters 'Era of Access and Opportunity'*, SPACE FOUND., https://www.thespacereport.org/uncategorized/state-of-space-2022-industry-enters-era-of-access-and-opportunity/ (last visited May 19, 2023).

[22] BRUNNER & SOUCEK, *supra* note 15, at 57-58.

revealed that in 2020 commercial space grew by 6.6%, representing almost 80% of the space economy.[23] Besides the 90 nations operating in space, 10 private companies were expected to undertake commercial space activities in 2022.[24] Not only is the number of private companies on the rise but so is public-sector interest in space operations.[25] Advanced technology, reusable space vehicles and declining costs of space launches have given rise to a facilitated global space industry whose estimated annual revenue is expected to increase to more than US$1 trillion by 2040.[26]

Moreover, according to Morgan Stanley, 50% of the growth of the global space economy by 2040 will be in launching a satellite that offers broadband internet service.[27] The advanced technology used to develop reusable space vehicles, has resulted in reduced launching costs which impacts the production of satellites to serve an increasing demand for the internet, autonomous cars and artificial intelligence, among others.[28]

In what has been termed the "*space-for-earth*" economy, goods are produced and services provided via space operations that will be used on Earth, to support among others, internet service, telecommunications and national security.[29] In this digital era, many private companies from different industries invest in satellite and space technology to increase their market shares and serve their future competitive positions.[30] Therefore, in reality, space is no longer only for the wealthiest of countries to carry out exploration. Moreover, the increasing global commercialization of space

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[23] *Global Space Economy Rose to $447B in 2020, Continuing Five Year Growth,* SPACE FOUND. (July 15, 2021), https://www.spacefoundation.org/2021/07/15/global-space-economy-rose-to-447b-in-2020-continuing-five-year-growth/.

[24] *Id*.

[25] *Space: Investing in the Final Frontier*, MORGAN STANLEY (July 24, 2020), https://www.morganstanley.com/ideas/investing-in-space.

[26] *Id*.

[27] *Id*.

[28] *Id*. ("Currently, the cost to launch a satellite has declined to about $60 million, from $200 million, via reusable rockets, with a potential drop to as low as $5 million. And satellite mass production could decrease that cost from $500 million per satellite to $500,000.")

[29] Matt Weinzierl & Mehak Sarang, *The Commercial Space Age is Here: Private Space Travel is Just the Beginning*, HARV. BUS. REV. (Feb. 12, 2021), https://hbr.org/2021/02/the-commercial-space-age-is-here.

[30] *Id*.

activities by private companies with the development of technology makes space ever more crowded.

State governments are investing more in space operations and spending more in support of private commercial space operations that directly impact human life.[31] The costs of these operations are justified by the benefits they provide for their citizens and by national pride.[32] More countries, particularly developing countries in Africa, South America and Asia are investing in space technologies.[33] These are the products not only of technological evolutions but are also driven by political motivation to gain prestige.[34] Although many of these countries do not have the technology and ability to establish influential national space policies, several have established national space agencies in recent years.[35]

With that said, there is another side to the coin of the booming space industry. More launches and re-entries mean commercial space operations demand more frequent access to airspace than ever before; the resulting interaction with civil aviation was discussed at the 13th Air Navigation Conference of ICAO (2018) (13th Air Navigation Conference) as an emerging issue impacting on the global air navigation system.[36]

Space transportation and risks arising from conflict zones were addressed as "future safety issues" at the 13th Air Navigation Conference.[37] The growth of space transportation and risks to civil aviation arising from conflict zones are also addressed in the 2017-2019 Edition of the ICAO Global Aviation Safety Plan (GASP) as

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[31] *Id*.

[32] *Id*.

[33] OECD PAPER FOR THE G20 SPACE ECONOMY LEADERS MEETING, SPACE ECONOMY FOR PEOPLE, PLANET AND PROSPERITY (2021), https://www.oecd.org/sti/inno/space-forum/space-economy-for-people-planet-and-prosperity.pdf.

[34] BRUNNER & SOUCEK, *supra* note 15, at 76-84.

[35] *Id*. at 84**.** For instance, the following national space agencies were established: South African National Space Agency (2010), Bahrain National Space Agency (2014), Kenya Space Agency in (2017), Zimbabwe National Geospatial and Space Agency (2018) and Turkish Space Agency (2018).

[36] ICAO Working Paper, *Other Emerging Issues Impacting the Global Air Navigation System*, ICAO 13TH AIR NAVIGATION CONFERENCE (2018), https://www.icao.int/Meetings/anconf13/Documents/WP/wp_013_en.pdf.

[37] ICAO Working Paper, *Future Safety Issues*, ICAO 13TH AIR NAVIGATION CONFERENCE (2018), https://www.icao.int/Meetings/anconf13/Documents/WP/wp_012_en.pdf.

emerging safety issues.[38] Clearly, the promising future developments in the space industry bring with them issues of air traffic management including sharing risks that directly affect public safety in overlapping air and space operations.[39]

Currently, considerable blocks of airspace are closed in the event of space launches, creating interruption and air traffic management challenges.[40] For instance, the US Federal Aviation Administration (FAA) stated that the February 6, 2018 launch at Kennedy Space Center caused 563 flights to be delayed.[41] This resulted in 34,841 additional nautical miles (NM) flown. An additional 62 NM were flown on average per flight for a total of 4,645 minutes of delays.[42] There was an average delay of eight minutes per flight, impacting 5,000 square NM.[43] Furthermore, there were 62 departure and 59 arrival delays alone at Orlando International Airport, located near Kennedy Space Center.[44]

When space launches were rare, and there was less civil aviation activity, the air traffic in affected areas was simply stopped or delayed through segregated administration.[45] This way, space vehicles and air traffic were kept clear by just blocking the traffic.[46] Now, the increasing density of commercial space launches, suborbital vessels and air activities, is closing large volumes of airspace causing delays as well as an increase in expenses incurred from expending additional fuel required by deviations from the usual, planned routes.[47] The segregation method is not really sustainable

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[38] ICAO GLOBAL AVIATION SAFETY PLAN (2017-2019) (ICAO Doc. 10004) (2d ed. 2016), https://www.icao.int/Meetings/a39/Documents/GASP.pdf.

[39] Ruth Stilwell & Diane Howard, *Integrating Space Operations in Aviation Safety Reporting*, ISASI FORUM (Aug. 2022), https://www.researchgate.net/publication/362680790_Integrating_Space_Operations_in_Aviation_Safety_Reporting.

[40] AIR LINE PILOTS ASS'N (ALPA) White Paper, SAFE INTEGRATION OF COMMERCIAL SPACE OPERATIONS INTO THE U.S. NATIONAL AIRSPACE SYSTEM AND BEYOND (2019), https://www.alpa.org/-/media/ALPA/Files/pdfs/news-events/white-papers/white-paper-aviation-space-follow-up.pdf?la=en [hereinafter ALPA 2019].

[41] *Id*.

[42] *Id*.

[43] *Id*.

[44] AIR LINE PILOTS ASS'N (ALPA) White Paper, ADDRESSING THE CHALLENGES TO AVIATION FROM EVOLVING SPACE TRANSPORTATION 10 (2018), https://www.alpa.org/~/media/ALPA/Files/pdfs/news-events/white-papers/white-paper-aviation-space.pdf.

[45] George D. Kyriakopoulos, *Spaceplanes Operating in Airspace: In Search of a Regulatory Regime for Traffic Coordination*, 60 PROC. INT'L SPACE L. 327, 334 (2017).

[46] *Id*.

[47] *Id*.

as a long-term solution to administer air and space operations in the integrated airspace.[48] Furthermore, one of the impacts of commercial space operations on civil aviation is addressed as an "undue burden on international airspace" because of the associated restrictions of commercial space launches that benefit one industry over another.[49]

Current developments indicate that the solution is to find a way to *integrate* the traffic in the airspace that would work as mutually beneficial for both industries.[50] Consequently, the necessity to govern the regime of international airspace based on the integration of air and space traffic has emerged.[51] There are ongoing discussions among air and space industry professionals and scholars regarding the need to address airspace management where overlapping air and space activities occur.[52] It can be said that the future of air and space commercial activities needs a predictable legal regime to provide clarity and certainty for business investments in future.

III. INTERNATIONAL NATURE OF NATIONAL SPACE ACTIVITIES

To date, the United Nations has been the leading actor in space governance. The Outer Space Treaty is the space treaty that still governs space operations today even as such operations are more complex nowadays.[53] More international mechanisms were developed for space law in the years following 1967.[54]

The Outer Space Treaty established through principles the foundations of international regulation of space activities and the

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[48] *Id*.

[49] ICAO WP 299, *supra* note 17.

[50] ALPA 2019, *supra* note 40, at 2.

[51] *See e.g.* RAM S. JAKHU, TOMMASO SGOBBA, & PAUL STEPHEN DEMPSEY, THE NEED FOR AN INTEGRATED REGULATORY REGIME FOR AVIATION AND SPACE: ICAO FOR SPACE? 126-28 (2011).

[52] MORGAN STANLEY, *supra* note 25.

[53] Outer Space Treaty, *supra* note 14.

[54] *See generally* Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, Apr. 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119 [hereinafter Rescue Agreement]; Convention on the International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S 187 [hereinafter Liability Convention]; and Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 18, 1979, 1362 U.N.T.S. 3 [hereinafter Moon Agreement].

framework of the legal regime.[55] Article I states: "[o]uter space, including the [M]oon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies."[56] States are free to use and explore outer space as they wish so long as they respect other States' rights, as underlined in Article IX's "due regard" provision.[57]

Article VI of the Treaty also states that the space 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.[58] That means States are solely responsible for regulating their outer space activities.[59] Also, they are responsible for complying with obligations derived from international law when regulating private actors' space activities such as licensing and authorizing space operations.[60] As a result, many States and private commercial companies operate space activities in the domain of outer space under many different national regulations.[61]

The Article VI principle of State supervision for commercial space activity does not provide specific requirements or minimum standards.[62] Therefore, the increasing commercial space activities of governmental and non-governmental entities worldwide raise many issues. For instance, States are left to interpret and implement Article VI of the Treaty regarding the definition of activities in space.[63] As a result, the scope of the categories and spacecraft that require licensing might differ from State to State.[64] Moreover,

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[55] Outer Space Treaty, *supra* note 14.

[56] *Id.* art. I.

[57] *Id*. art. IX ("States Parties to the Treaty shall be guided by the principle of cooperation and mutual assistance and shall conduct all their activities in outer space, including the [M]oon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty.").

[58] *Id*. art. VI.

[59] *Id*.

[60] *Id*.

[61] *See generally* NATIONAL SPACE LEGISLATION: A COMPARATIVE AND EVALUATIVE ANALYSIS (Annette Froehlich & Vincent Seffinga eds. 2018).

[62] Outer Space Treaty, *supra* note 14, art. VI.

[63] *Id*.

[64] Frans G. von der Dunk, *Kiwi's in Space: New Zealand's Outer Space and High-Altitude Activities Act*, 60 PROC. INT'L SPACE L. 453, 458 (2017).

commercial space activity may occur in a jurisdiction of a State that cannot supervise or even in a jurisdiction of a State that is not party to the Outer Space Treaty.[65]

The motivation for national space regulations may also differ from State to State. Generally, the leading factor in an economic environment with a commercially growing industry is more profit-seeking than compliance-seeking with non-binding standards.[66] As regarding national space regulations, other motives also exist, including national security, the role the State aims to play in world politics, international status and national prestige.[67]

Considering the current developments, which were not predictable in 1967, the existing framework of the international system for outer space activities may be seen as outdated. It was not established to address a variety of new space activities that developed parallel to technological innovations, which were not necessarily foreseeable in 1967, which indicates the existence of gaps in the Outer Space Treaty that allow for interpretations that may cause conflict in practice.[68] As a result, an unprecedented increase in space activities through independent acts of States can create a risk to other States and their habitats.

That non-governmental, commercial space activities and various actors have become active in space has raised concerns that regulatory governance of space activities should be established, including binding and harmonized standards.[69] Numerous national regulatory approaches concerning State compliance with international obligations while implementing supervisory responsibility of

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[65] Ronald L. Spencer Jr, *International Space Law: A Basis for International Regulation*, *in* NATIONAL REGULATION OF SPACE ACTIVITIES 3 (Ram S. Jakhu ed. 2010).

[66] *See generally* Christopher J. Newman, *Seeking Tranquillity: Embedding Sustainability in Lunar Exploration Policy,* 33 SPACE POL'Y 29 (2015). *See* John Saba, *Worldwide Safe Flight: Will the International Financial Facility for Aviation Safety Help It Happen*, 68 J. AIR L. & COM. 537 (Summer 2003).

[67] *See* DEGANT PAIKOWSKY, THE POWER OF THE SPACE CLUB (2017).

[68] Sophie Goguichvili et al., *The Global Legal Landscape of Space: Who Writes the Rules on the Final Frontier?*, ACROSS KARMAN (Oct. 1, 2021), https://acrosskarman.wilsoncenter.org/article/global-legal-landscape-space-who-writes-rules-final-frontier.

[69] *See* Doucet, *supra* note 18; Claudiu Mihai Taiatu, *Space Traffic Management: Top Priority for Safety Operations*, 60 PROC. INT'L. INST. SPACE L. 15 (2017); Gilles Doucet & Cassandra Steer, *The Use of Space Technology Export Controls as a Bargaining Solution for Sustainability: A Chicago Convention Model of Space Governance*, 60 PROC. INT'L. INST. SPACE L. 567 (2017).

national space activities in outer space makes for messy patchwork.[70] However, it is challenging to bring governments together to accept binding standards for outer space activities. Although one day, it may be inevitable.

IV. THE CHALLENGES

Considering the current and future emerging economic value of space-to-Earth businesses, not having international binding rules and standards seems a desirable freedom for the space industry and States.

When we consider the experience of the air transport market developments, driven by liberalization, rapid market developments in air transport led the air industry to find ways to build freer markets through innovation in operational and business aspects of civil aviation practices. It was feared that air transport market practices resulting from air transport liberalization, employed in a liberalized air transport market—such as code-share agreements, operating with a foreign-registered aircraft, operating with a foreign flight crew, off-shore operations, mergers and acquisitions, outsourcing of activities that affect aircraft operations and possible developments toward a "flags of convenience" for aircraft—would lead to "registry shopping;"[71] in other terms, for airlines to avoid certain countries to circumvent being subjected to stricter regulations.[72]

When there is a large common market with significant economic power, the general policy is either not to have restrictions or otherwise find a way to avoid regulations.[73] However, it is foreseeable that the diversity of the activities and the actors in space will increase, and the current system based on national policies will become inefficient. Therefore, new space governance based on international collaboration will be inevitable.[74]

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[70] Spencer Jr., *supra* note 65, at 21.

[71] Philip Donges Snodgrass, *Aviation Flags of Convenience: Ireland and the Case of Norwegian Airlines International*, 14 ISSUES IN AVIATION L. & POL'Y 245, 274 (2014-2015).

[72] *Id.*

[73] *See* NILGUN OZGUR, GLOBAL GOVERNANCE OF CIVIL AVIATION SAFETY 59-123 (Routledge 2022).

[74] Goguichvili, *supra* note 68.

V. IMPACT OF COMMERCIAL SPACE OPERATIONS ON CIVIL AVIATION SAFETY

The immediate concern for civil aviation safety is that the space industry uses airspace now more than ever.[75] Two main areas of concern are with respect to air traffic management within the integrated airspace and orbital debris.

A. Air Traffic Management in Integrated Airspace

Currently, airspace management is maintained by restricting airspace during the launch and re-entry of spacecrafts.[76] Although the space operations of each State are implemented according to the rules and regulations of the State authority, the nature of space operations has become more international and thus requires a certain level of international collaboration within the airspace.[77]

For instance, the US FAA states that since 1989 there have been 511 space launches, of which 54 occurred in 2021 and 79 in 2022.[78] The total number of re-entries since 2010 is 34.[79] It was noted that in 2022 there were more launches than at any time in history, led by rockets from US company SpaceX, the Chinese government and Chinese businesses.[80] In 2022, 180 rocket launches were reported.[81] The US operated 76 licensed launches including SpaceX, China 62, Russia 21, New Zealand 9, Europe 5 and others 7.[82] It is noted that because of the Russian invasion of Ukraine in February 2022, the European Space Agency (ESA) did not launch

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[75] Jackie Williams, *Space is Becoming Too Crowded, Rocket Lab CEO Warns,* CNN (Oct. 8. 2020), https://www.cnn.com/2020/10/07/business/rocket-lab-debris-launch-traffic-scn/index.html.

[76] *Let's Give 'Em Some Space,* MEDIUM (May 3, 2023), https://medium.com/faa/lets-give-em-some-space-4028dea2e7d8.

[77] *Cooperative Operations in Higher Airspace: A Proposal*, AEROSPACE INDUSTRIES ASS'N (Apr. 2022), https://www.aia-aerospace.org/wp-content/uploads/AIA-Cooperative-Operations-in-Higher-Airspace-Proposal-April-2022-Final33.pdf.

[78] *Commercial Space Data*, US DEP'T OF TRANSP., FED. AVIATION ADMIN., https://www.faa.gov/data_research/commercial_space_data/ (last visited May 20, 2023).

[79] *Id.*

[80] Alexandra Witze, *2022 was a Record Year for Space Launches*, NATURE (Jan. 11, 2023), https://www.nature.com/articles/d41586-023-00048-7.

[81] *Id.*

[82] *Id.*

Russian Soyuz rockets as part of the sanctions imposed on Russia by ESA Member States.[83]

The significant developments in space commerce indicate that this growth trend will increase in the coming years.[84] More operators with diverse vehicles are using the integrated airspace where ICAO has competency as a regulatory authority to govern international air navigation and ensure safe and orderly international civil aviation.[85]

The current practice of governing integrated airspace is based on segregation.[86] That means that all spacecraft launches require that a specific area of airspace is reserved.[87] The launching State collaborates with air navigation service providers (ANSP) to determine the restricted airspace needed to maintain the safety of both launch vehicles and aircraft. After consultation, the launching State will issue a temporary flight restriction (TFR) and publish a notice to airmen (NOTAM).[88]

Article 2 of the Convention on Registration of Objects Launched into Outer Space, adopted by Resolution 3235 (XXIX) of the UN General Assembly, states that the launching State shall also register space objects when such space objects are launched into Earth orbit or beyond.[89] However, not every launch is registered with the United Nations, sometimes for security reasons.

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[83] *N° 9–2022: ExoMars Suspended,* EUR. SPACE AGENCY (Mar. 17, 2022), https://www.esa.int/Newsroom/Press_Releases/ExoMars_suspended.

[84] John Coykendall et. al., *Riding the Exponential Growth in Space,* DELOITTE (Mar. 22, 2023), https://www2.deloitte.com/us/en/insights/industry/aerospace-defense/future-of-space-economy.html.

[85] *Regulation of Emerging Modes of Aerospace Transportation (REMAT),* ICAO, https://www.icao.int/meetings/remat/pages/default.aspx (last visited May 20, 2023).

[86] *Commercial Space Integration into the National Airspace System*, FED. AVIATION ADMIN. (May 2020), https://www.faa.gov/space/airspace_integration/media/Final_CSINAS_ConOps.pdf.

[87] *Id*.

[88] ICAO Working Paper, *Coordination of Flights Through Controlled Airspace for Space and Near Space Operations*, ICAO 13th Air Navigation Conference (2018) https://canso.fra1.digitaloceanspaces.com/uploads/2020/04/wp_173_en-COORDINATION-OF-FLIGHTS-THROUGH-CONTROLLED-AIRSPACE-FOR-SPACE-AND-NEAR-SPACE-OPERATIONS.pdf [hereinafter ICAO WP 173]. ("The size of the restricted airspace for a typical NASA Shuttle launch was 30-40 nautical miles long and wide, closing off approximately 1,500 square miles to commercial and general aviation.")

[89] Convention on Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15 [hereinafter Registration Convention].

However, there is no obligation to register before launching.[90] Therefore**,** the lack of information regarding space launches and their location fails the Notice to Air Missions (NOTAM) system.[91]

Moreover, uncrewed aircraft travel and operate *near* space, such as Google's Project Loon; more companies are expected soon.[92] ANSPs should be able to follow these operations during their ascent and descent through controlled airspace.[93] This indicates the increasing and complicated workload on ANSPs.[94] Therefore, guidance with harmonized standards becomes crucial for global navigation aviation safety.

The European Union Aviation Safety Agency (EASA), as part of the Strategic Priorities of European Plan for Aviation Safety (EPAS 2023-2025), also underlines the developments of spaceports in some European Union (EU) Member States and the anticipation of European operations in the higher airspace either crewed or uncrewed.[95] Furthermore, EASA recognizes aviation safety risks through integrated airspace, suggesting that

> EU Regulations need to be adapted or new ones adopted, among others, in the field of airworthiness, operations, personnel, ATM/ANS, aerodromes/spaceports and environment, taking due account of the respective competencies of the EU and Member States."[96]

EUROCONTROL developed the European Concept of Operations for Higher Airspace—the (ECHO) SESAR 2020 project—to enable safe, efficient and scalable operations above the flight levels

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[90] *Id*.

[91] Paul B. Larsen, *Space Activities and Their Effect on International Civil Aviation*, 9 PROC. ON OUTER SPACE 159 (1966).

[92] Casey Newton, *Facebook Takes Flight,* THE VERGE, https://www.theverge.com/a/mark-zuckerberg-future-of-facebook/aquila-drone-internet (last visited May 20, 2023).

[93] Wilfredo Torres-Pomales, *Conformance Monitoring in Air Traffic Control*, NAT'L AERONAUTICS AND SPACE ADMIN (May 2020), https://ntrs.nasa.gov/api/citations/20200002943/downloads/20200002943.pdf.

[94] ICAO WP 173, *supra* note 88.

[95] European Plan for Aviation Safety (EPAS 2023-2025) Vol.1 at 77, EUR. UNION AVIATION SAFETY AGENCY, https://www.easa.europa.eu/en/downloads/137466/en (last visited Feb. 23, 2024).

[96] *Id.*

where conventional air traffic operates.[97] In the work of the ECHO SESAR 2020 project, there is close coordination with EASA to develop the future European Higher Airspace Operation regulatory framework.[98] Also, the project collaborates with the ICAO global framework to establish a globally harmonized approach for higher airspace operations.[99]

ICAO included the concept of suborbital flights in its work program in 2005.[100] The Council of ICAO highlighted that the ICAO Annexes lack technical requirements in sub-orbital flights and concluded that there is no clear indication in international law on the delimitation between airspace and outer space that would permit them to conclude on the applicability of either air law or space law to suborbital flights.[101]

The increasing number of commercial space activities has changed the governing concept of traditional civil aviation operations only thirteen years later.[102] Aviation safety risks created by the increasing number of commercial space launches, reusable launch vehicles and associated debris fields were discussed at the ICAO 13th Air Navigation Conference in 2018. ICAO's role as a global regulatory institution able to ensure safe and orderly

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[97] *Exploratory Research Project: ECHO – European Concept of Operations for Higher Airspace Operations,* SESAR, https://www.sesarju.eu/projects/echo (last visited May 20, 2023).

[98] *Id.*

[99] *European Concept for Higher Airspace Operation (ECHO),* EUROCONTROL, https://www.eurocontrol.int/project/european-concept-higher-airspace-operation (last visited May 20, 2023).

[100] ICAO Working Paper, *Concept of Sub-Orbital Flights*, COUNCIL MEETING 175TH SESS. (2005), https://www.unoosa.org/pdf/limited/c2/AC105_C2_2010_CRP09E.pdf [hereinafter Concept of Sub-Orbital Flights].

[101] *Id.*

> ICAO Annexes currently lack technical requirements in this area. Assembly Resolution A35-14, Appendix G nevertheless acknowledges that for certain categories of aircraft or classes of airmen, it may be many years before SARPs come into force or that it may be found most practicable not to adopt SARPs. Accordingly, Resolving Clause 2 stipulates that 'certificates and licenses issued or rendered valid, under national regulations, by the Contracting State in which the aircraft is registered shall be recognized by the other Contracting States for the purpose of flight over their territories, including landings and take-offs.

Id.

[102] ICAO WP 173, *supra* note 88.

international civil aviation in the integrated airspace was highlighted.[103] Discussions explored safety concerns regarding the increased frequency of commercial space launches, the recovery of expended stages, reusable vehicles and their associated debris fields.[104] In addition, the urgency of developing regulatory guidance materials such as Standards and Recommended Practices (SARPs) related to the management of integrated airspace was addressed.[105]

In 2022, at the 41st General Assembly of ICAO, new and complex challenges for the civil aviation community, including drones, commercial space operations and other higher altitude operations, were again underlined.[106] It was suggested that there is a need for *fundamental change* in the global aviation system.[107] Accordingly, integrated analysis that covers both users of conventional aviation operations and emerging airspace operations for air traffic and aerospace management is needed to enable global civil aviation advancement.[108]

The aims and objectives defined in the Chicago Convention give the ICAO competency to foster the planning and development of international air transport to insure the safe and orderly growth of international civil aviation worldwide.[109] Addressing this competency, ICAO was asked to take the lead to advance the development of a global consensus on the next air traffic and aerospace management era.[110]

ICAO also adopted a Resolution (A41-9) for "New Entrants," which refers to higher airspace operations and uncrewed aircraft systems as well as traffic management operations. Accordingly, ICAO recognizes the "increasing need to facilitate, within a global, harmonized framework, operations by New Entrants and that there is a large disparity in performance in the types of vehicles expected

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103 *Id*.

104 *Id*.

105 ICAO WP 299, supra note 17.

106 ICAO Working Paper, *The Next Era of Air Traffic and Air Space Management*, 41ST GENERAL ASSEMBLY MEETING (2022), https://www.icao.int/Meetings/a41/Documents/WP/wp_087_en.pdf [hereinafter ICAO WP 87].

107 *Id*.

108 *Id*.

109 Chicago Convention, *supra* note 19.

110 ICAO WP 299, supra note 17.

to comprise this new airspace user group."[111] However, in this Resolution, ICAO also underlines its role as a global forum "to facilitate improved cooperation, collaboration and the sharing of best practices in support of regional initiatives and to undertake the necessary follow-up activities that build on those initiatives by encouraging increased dialogue between States, New Entrants, existing aviation stakeholders and the space community."[112]

Defining ICAO as a "global forum" does not fit the aims and objectives of ICAO as specified in the Chicago Convention.[113] Instead, ICAO can and should take a more leading authoritative and regulatory role to develop a global consensus that addresses fundamental change in the global aviation system.

B. Safety Risks for Civil Aviation Created by Orbital Debris

Considering the great variety of space vehicles and activities, the general definition of orbital debris applies to "all [hu]man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional."[114]

In 1978, while the current types of space operations were perhaps unimaginable, scientists Donald J. Kessler, John Gabbard and Nicholas L. Johnson predicted that orbital debris would continually collide with other orbital debris and create a cascade effect of uncontrolled collision, eventually multiplying the number of debris in Earth's orbit. This theory is known as the "Kessler Syndrome."[115] According to Kessler Syndrome, the amount of orbital debris resulting from growing space operations has reached a level at which it seems even efforts to reduce the debris will not effectively help to

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[111] ICAO Res. A41-9, New Entrants (2022), https://www.icao.int/Meetings/a41/Documents/Resolutions/a41_res_prov_en.pdf.

[112] *Id*.

[113] *Vision and Mission*, ICAO, https://www.icao.int/about-icao/Council/Pages/vision-and-mission.aspx (last visited May 19, 2023).

[114] UNITED NATIONS OFF. FOR OUTER SPACE AFFS. (UNOOSA), SPACE DEBRIS MITIGATION GUIDELINES OF THE COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE, (2010), https://www.unoosa.org/pdf/publications/st_space_49E.pdf.

[115] *See* Donald J. Kessler & Burton G. Cour-Palais, *Collision Frequency of Artificial Satellites: The Creation of a Debris Belt,* 83 J.GEOPHYS. RES. 2637 (1978).

solve.[116] This raises serious safety concerns for the global space community.[117]

According to European Space Agency (ESA), the number of debris objects estimated based on statistical models to be in orbit is 36,500 space debris objects greater than 10 cm, one million space debris objects from greater than 1 cm to 10 cm, 130 million space debris objects from greater than 1 mm to 1 cm.[118]

According to the National Aeronautics and Space Administration (NASA), approximately 25,000 pieces of debris larger than a softball (approximately 10 centimeters) are orbiting the Earth.[119] Traveling at up to 15 km/second, they are capable of causing significant damage to a spacecraft.[120] In addition, it is estimated that there are half a million pieces of debris between 1 and 10 cm in diameter.[121] In short, there are more than 100 million pieces of debris-about larger than one millimeter.[122] The collision of space debris is a threat to the safety of outer space activities and a threat to the safety of civil aircraft.

The growth of the commercial space actor, including private companies operating without internationally agreed standards and regulations, is leading to uncontrolled outer space activities. As a result, the debris population in orbit is growing as a threat to Earth and aviation.[123] Each space launch adds more space objects in orbit. Therefore, more space launches cause more space objects. For instance, in 2020, 522 objects were placed in orbit as a result of 102

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[116] *See also* Paul B. Larsen, *Minimum International Norms for Managing Space Traffic, Space Debris, and Near-Earth Object Impacts*, 83 J. AIR L. & COM. 739 (2018).

[117] *See* James D. Rendleman, *Non-Cooperative Space Debris Mitigation*, 53 PROC. INT'L INST. SPACE L. 299 (2010).

[118] *Space Debris by the Numbers,* EUR. SPACE AGENCY, https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers (last visited May 20, 2023).

[119] *Frequently Asked Questions*, NAT'L AERONAUTICS AND SPACE ADMIN., https://orbitaldebris.jsc.nasa.gov/faq/ (last visited Dec. 15, 2023).

[120] *Id*.

[121] *Id*.

[122] *Id*.

[123] *Space Situational Assessment 2021*, INDIAN SPACE RSCH. ORG. DEP'T OF SPACE, https://www.isro.gov.in/SSA.html (last visited May 28, 2024). ("It is expected that number of operational satellites will surpass the number of space debris by 2030. Consequently, the total number of space objects of more than 10 cm sized in LEO is expected to be about 60000 by 2030.")

launches.[124] One thousand eight hundred sixty objects were placed in orbit with 135 launches in 2021.[125] More than 60% of objects added to space are from large Low Earth Orbit satellite constellations, mainly from the SpaceX Starlink[126] constellation.[127]

According to the Index of Objects Launched into Outer Space, maintained by the United Nations Office for Outer Space Affairs (UNOOSA), there were 12,293 objects launched into space at the end of January 2022.[128] At the time, 8,261 individual satellites were orbiting the Earth, an increase of 11.84% compared to April 2021.[129]

In 2021, Spacetrack reported that on-orbit break-up events generated 150 fragment objects, and two collision events produced 942 objects.[130] In addition, 515 space objects re-entered the Earth's atmosphere due to natural decay.[131] Furthermore, NASA's Orbital Debris Quarterly News indicates that the number of larger fragments continues to increase.[132] The report also indicates that the number of fragments greater than 10 mm increased by 43% from February 2022 to October 2022.[133]

According to ESA, every year approximately 100 tons of defunct satellites, uncontrolled spacecraft and discarded items are dragged down by Earth's upper atmosphere and burned across the sky.[134] However, some of the larger objects will not burn and

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[124] *Id*.

[125] *Id*.

[126] Tereza Pultarova et al., *Starlink Satellites: Everything You Need to Know about the Controversial Internet Megaconstellation,* SPACE.COM (Nov. 23, 2022), https://www.space.com/spacex-starlink-satellites.html. ("Starlink is the name of a satellite network developed by the private spaceflight company SpaceX to provide low-cost internet to remote locations…The current V2 Starlink satellite weighs approximately 1,760 lbs [800 kilograms].")

[127] *Space Debris and Human Spacecraft*, *supra* note 118.

[128] Nibedita Mohanta, *How Many Satellites are Orbiting Around Earth in 2022?*, GEOSPATIAL WORLD (Apr. 20, 2023), https://www.geospatialworld.net/prime/business-and-industry-trends/how-many-satellites-orbiting-earth.

[129] *Id*.

[130] *Space Situational Assessment 2021*, *supra* note 123.

[131] *Id*.

[132] *International Space Station Maneuvers Avoid to Another Russian ASAT Fragment*, 26 NASA'S ORBITAL DEBRIS Q. 1, 1-2 (Dec. 2022), https://orbitaldebris.jsc.nasa.gov/quarterly-news/pdfs/odqnv26i4.pdf.

[133] *Id*.

[134] *ESA Re-Entry Expertise*, EUR. SPACE AGENCY (Mar. 30, 2018), https://www.esa.int/Safety_Security/Space_Debris/ESA_reentry_expertise.

disappear into the sky – instead, they will reach the Earth.[135] Generally, with controlled re-entry, the spacecraft is steered to a specific flight path when it enters the atmosphere.[136] Therefore, the debris can be situated over a region with no habitation, or in the ocean.[137] With uncontrolled re-entries, however, the impact of the surviving debris cannot be controlled, and avoidance of landmass cannot be guaranteed.[138] As such, uncontrolled re-entries of orbital debris pose a threat to aircraft and people on Earth.[139]

For instance, in 1996, an unknown flying object hit the cockpit window of a Chinese Boeing 757 with 200 passengers and caused a crack while the aircraft was flying at an altitude of 9600km.[140] As a result, the aircraft made an emergency landing at Beijing's Capital International Airport.[141] In another incident, on March 27, 2007, an Airbus A340 of LAN Airlines flying between Santiago, Chile, and Auckland, New Zealand carrying 270 passengers, noticed debris within 8 km of the aircraft from Russian Progress 23P cargo.[142] The pilot reported "hearing the sonic boom as it passed."[143]

The February 2003 space shuttle Columbia disaster demonstrates how things can go terribly wrong and create risk for aviation. The space shuttle uncontrollably shed debris in airspace for 40 minutes.[144] During the accident, the possibility of a collision with debris was estimated to be 1/1000 for commercial airliners in the area and 1/100 for general aviation.[145]

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[135] *Id*.

[136] *Id*.

[137] *Debris Re-Entry*, NAT'L AERONAUTICS AND SPACE ADMIN., https://orbitaldebris.jsc.nasa.gov/reentry/ (last visited May 20, 2023).

[138] *Id*.

[139] Wayne Rosenkrans, *Extraterrestrial Debris*, FLIGHT SAFETY FOUND. (Mar. 14, 2012), https://flightsafety.org/asw-article/extraterrestrial-debris/.

[140] Paul Marks, *Dodging Debris*, AEROSPACE AMERICA (July/Aug. 2021), https://aerospaceamerica.aiaa.org/features/dodging-debris/.

[141] *Id*.

[142] Matteo Emanuelli & Tobias Lips, *Risk to Aircraft from Space Vehicles Debris*, 52ND SESS. UNCOPUOS SCIENTIFIC & TECH. SUBCOMM. (2015), https://www.unoosa.org/pdf/pres/stsc2015/tech-29E.pdf.

[143] *Id*.

[144] Rosenkrans, *supra* note 139.

[145] Tommaso Sgobba, *Space Debris Re-entries and Aviation Safety,* IAASS, https://iaaspace.org/wp-content/uploads/iaa/Scientific%20Activity/debris6.pdf (last visited May 20, 2023) [hereinafter Sgobba pres.].

The Columbia disaster and the risk created for aviation safety were wake-up calls. Prior to the disaster, the US Federal Aviation Administration (FAA) and NASA had reached a collaborative work process to prevent risks for aircraft flying within the airspace during the launching and landing operations of the space shuttle.[146] This included the development of the Shuttle Hazard Area to Aircraft Calculator (SHAAC).[147] The SHAAC system included both related departments from NASA and the US FAA working in close coordination to figure out the risks within the airspace during reentry operation of Reusable Launch Vehicles. [148] The unfortunate Columbia Shuttle experience made it very clear that there should be close cooperation between air traffic management and space operation within the airspace.

There are also considerable costs to aviation related to uncontrolled re-entries. For instance, on Sunday, January 15, 2012, Russian authorities reported an uncontrolled re-entry that led EUROCONTROL to close Europe's airspace for two hours, costing approximately EUR 20 million.[149]

The incident reports involving space debris re-entries are increasing, and so are the objects that reach Earth.[150] This creates a heightened risk of collision with aircraft. Luckily, at the time of writing such incidents have been confined to aircraft being hit by small debris and causing an emergency landing—there have been no fatal aircraft accidents.[151] However, with the increasing space

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[146] Doyle W. Hensley et al., *Evolution of National Airspace System Protection for Space Shuttle Launch and Landing*, NAT'L AERONAUTICS AND SPACE ADMIN., https://ntrs.nasa.gov/api/citations/20210021251/downloads/2013-AIAA-AeroSciences-Shuttle-FINAL.docx.pdf (last visited May 20, 2023).

[147] Tommaso Sgobba, *Space Debris Alert System for Aviation*, 6 PROC. IAASS CONF. (May 2013), https://articles.adsabs.harvard.edu/pdf/2013ESASP.715E..72S (last visited May 20, 2023).

[148] *Id.*

[149] Sgobba pres., *supra* note 145.

[150] *Re-Entry Impact Indonesia*, EUR. SPACE AGENCY, https://reentry.esoc.esa.int/home/blog/reentry-impact-indonesia (last visited May 20, 2023) (stating that "[o]n the 18th of July 2017, near Sungai Batang on the Indonesian island of Sumatra, locals found a sphere of approximately 50 cm in diameter and 7.4 kg in mass" enter over Hawaii); *see also Milwaukee Incident,* EUR. SPACE AGENCY, https://reentry.esoc.esa.int/home/blog/milwaukee-incident (last visited May 20, 2023) (stating that "on the 22nd of December 2016 a local news station reported that a few days earlier in Milwaukee, United States, an object had fallen from the skies and damaged a parked van.").

[151] *Id.*

operations and satellites, the risk of fatal aircraft accidents is also increasing.[152]

A recent study by William H. Ailor indicates the cumulative hazard level for people on the ground and in aircraft from falling debris following re-entries of satellites.[153] The study shows that an increasing number of re-entry of satellites can create risk for people on the Earth and in aircraft.[154] It also indicates that the disposal of large numbers of satellites from constellations could potentially increase the likelihood of a casualty on the ground or in aircraft by debris falling after re-entry.[155] The probability of re-entering space debris striking a commercial aircraft will increase as the number of commercial airline flights increases and as the debris population in low Earth orbit increases.[156]

The United Nations Office for Outer Space Affairs published Guidelines for Space Debris Mitigation in 2007.[157] In 2019, the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) adopted voluntary, non-binding Guidelines for the Long-term Sustainability of Outer Space Activities (COPUOS LTS Guidelines)[158] to "provide guidance on the policy and regulatory framework for space activities; safety of space operations; international cooperation, capacity-building and awareness; and scientific and technical research and development."[159]

Also, in 2019 "Space Safety" was adopted as a key pillar of ESA's activities, and included the first space mission to remove an

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[152] Rosenkrans, *supra* note 139.

[153] William H. Ailor, *Hazards of Reentry Disposal of Satellites from Large Constellations*, 6 J. SPACE SAF. ENG. 113 (June 2019).

[154] *Id.*

[155] *Id.* at 113.

> [T]he probability of debris striking a commercial aircraft would be 0.001/year, and without emergency action by pilots, the maximum yearly casualty expectation for reentries of satellites disposed from a single large constellation for people in aircraft could be 0.3/year. Those estimates would be higher if commercial air traffic were updated to include all worldwide flights.

[156] Sgobba, *supra* note 147.

[157] Space Debris Mitigation Guidelines, *supra* note 114.

[158] Rep. of the Comm. on the Peaceful Uses of Outer Space on its Sixty-second Session, U.N. Doc. A/74/20, at ¶ 163 (2019), https://www.unoosa.org/res/oosadoc/data/documents/2019/a/a7420_0_html/V1906077.pdf.

[159] *Id.* annex II.

item of debris from orbit.[160] However, further critical safety and security issues were raised after Russia, on November 15, 2021, used an antisatellite weapon to destroy one of its satellites that had been in orbit since 1982.[161] The test resulted in at least 1,500 trackable pieces of debris in low orbit, threatening space operations and human spaceflight.[162]

Russia's antisatellite test with its consequences, namely, the generation of a large amount of space debris and the subsequent creation of long-lasting risk for crewed and un-crewed space activities, including the safety of astronauts and cosmonauts at the International Space Station, was defined as "irresponsible behavior" and condemned by European Council.[163] The US also issued statements and criticized Russia's test for endangering the use of outer space for peaceful purposes.[164]

In his opening speech at the 2023 European Space Conference in Brussels,[165] Vice President for EU Foreign Affairs and Security Policy, Josep Borrell, drew attention to space threats.[166] He emphasized that space has become a "key battlefield" for security and defense where competition and confrontation will occur.[167] Accordingly, he called upon the international community to work

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[160] Robin Biesbroek et al., *The ClearSpace-1 Mission: ESA and ClearSpace Team Up to Remove Debris*, EUR. SPACE AGENCY (May 2021), https://conference.sdo.esoc.esa.int/proceedings/sdc8/paper/320/SDC8-paper320.pdf (last visited May 20, 2023).

[161] Shannon Bugos, *Russian ASAT Test Creates Massive Debris*, ARMS CONTROL ASS'N (Dec. 2021), https://www.armscontrol.org/act/2021-12/news/russian-asat-test-creates-massive-debris.

[162] *Id*.

[163] Council of the EU Press Release, Statement by the High Representative of the Union for Foreign Affairs and Security Policy on Behalf of the EU on the Russian Antisatellite Test on November 15 2021 (Nov. 2021), https://www.consilium.europa.eu/en/press/press-releases/2021/11/19/statement-by-the-high-representative-of-the-union-for-foreign-affairs-and-security-policy-on-behalf-of-the-eu-on-the-russian-anti-satellite-test-on-15-november-2021/.

[164] Press Statement, Antony J. Blinken, Secretary of State, Russia Conducts Destructive Anti-Satellite Missile Test (Nov. 2021), https://www.state.gov/russia-conducts-destructive-anti-satellite-missile-test/.

[165] *Securing the Future of Europe in Space*, 15th European Space Conf. (Jan. 24 - 25 2023), https://spaceconference.eu/.

[166] EEAS Press Team, *European Space Conference: Opening Speech by High Representative/Vice-President Josep Borrel*, 15th European Space Conf. (Jan. 2023), https://www.eeas.europa.eu/eeas/european-space-conference-opening-speech-high-representativevice-president-josep-borrell_en.

[167] *Id*.

collaboratively on securing space, saying, "without security in space, there will not be security on Earth. We will not be secure if we do not control what is happening in outer space."[168]

Without a doubt, orbital debris has become a global concern. The emerging necessity to adopt a regime to mitigate orbital debris for both space and air space safety is crystal clear.[169]

UNOOSA and ESA have worked collaboratively to raise awareness about the risks and solutions for sustainable space explorations. The increasing number of countries and private companies in various space activities, such as satellite operations, and the increasing number of space object launches with heavy constellations, create challenges in the space environment and integrated airspace. ESA and UNOOSA jointly produced a report with illustrations, facts and figures to clearly explain the dangers of orbital debris and the risks re-entries pose to people and the Earth. [170] The report also includes discussion of technology for safe debris mitigation and removal.[171] The regulatory system for space commercial and non-commercial activities can eventually control and reduce orbital debris safety risks.[172] However, the advancement of space technologies is advancing swiftly, and current guidelines are inadequate to manage orbital debris and control its impact on the Earth.

The private space industry invests in technology to develop more advanced space objects to increase their share of the "Space-to-Earth business."[173] For instance, in 2018, the private space industry introduced new space objects called SpaceBEEs using swarm technology.[174] Despite US company Swarm Technologies making an application to the FCC that was denied, the Indian Space Research Organisation allowed the launch of four of the

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[168] *Id.*

[169] *See* Gershon Hasin, *Confronting Space Debris through the Regime Evolution Approach*, 97 INT'L' L. STUD. SER. US NAVAL WAR COL. 1073 (2021).

[170] *ESA and UNOOSA Illustrate Space Debris Problem*, EUR. SPACE AGENCY (Feb. 10, 2021), https://www.esa.int/Space_Safety/Space_Debris/ESA_and_UNOOSA_illustrate_space_debris_problem.

[171] *Id.*

[172] Rendleman, *supra* note 117, at 749.

[173] Scarlet Wagner, *BEEs in Space: Swarm Technologies' Unauthorized Deployment of Smallsats and Article VI of the Outer Space Treaty*, 61 PROC. INT'L SPACE L. 129, 130 (2018).

[174] *Id.*

company's space objects into orbit on Jan. 12, 2018.[175] However, the unpredictable impact of these new technology devices is that they increase the space debris problem.

There have been expanding developments in the private space industry. The commercialization of space activities attracts more investors in technology in this "free market" field.[176] It is called free because of the current international agreement, the Outer Space Treaty, which states that outer space shall be free for exploration and use by all States. [177] While States do have an obligation to use outer space in accordance with international law,[178] many private companies in the space industry have new technological devices, such as SpaceBEEs, that trigger concerns about irresponsible attempts to launch unauthorized satellites. Therefore, the question arises of how the system ensures the use of outer space is in accordance with international law.

VI. INTEGRATED AIRSPACE SAFETY GOVERNANCE WITHIN THE FRAMEWORK OF THE CHICAGO CONVENTION

Space activities are developing under each State's authority and national regulations. However, considering the increasing activities in space, the frequency of operations and sharing of integrated airspace without international collaboration, safety concerns for civil aviation are created. Furthermore, the current practice of segregation will not be sustainable with the increasing frequency of space launch operations in future. The expanding volume and complexity of commercial space operations suggest the need to identify and resolve immediate ways in which to manage integrated airspace.

The growing sectorial operations in air transport and commercial space activities have raised legal issues, especially regarding defining the competent authority to regulate these activities, for instance where commercial suborbital flights affect civil aviation air

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[175] *Id*.

[176] Rob Bland et. al., *A Different Space Race: Raising Capital and Accelerating Growth*, MCKINSEY & CO. (Nov. 16, 2022), https://www.mckinsey.com/industries/aerospace-and-defense/our-insights/a-different-space-race-raising-capital-and-accelerating-growth-in-space.

[177] Outer Space Treaty, *supra* note 14, art. I.

[178] *Id.* art. III.

traffic management.[179] Therefore, the ICAO Council, during the 13th meeting of its 174th Session, approved the inclusion of the item "Concept of sub-orbital flights" in the work program for the 175th Session (C-DEC 174/13).[180] In addition, the ICAO Secretariat presented its analysis regarding the competent authority for suborbital flights at the ICAO Council's 175th Session.[181] According to this analysis, air law may "prevail" since airspace is a common area for aircraft and sub-orbital vehicles' descending and ascending operations.[182]

Scholars and professionals from both air and space industry fields suggested various systems that empower ICAO's competence to include regulating space and near-space operations to the extent that they impact on the international civil aviation system by creating SARPs so far as the international community deems necessary.[183] While ICAO is the specialized UN agency for international civil aviation, its competence and current structural capability to regulate commercial space activities with binding standards is called into question.[184] In addressing future structures to govern space operations within the integrated airspace, however, the competence of ICAO needs to be defined as a possible first step.

A. The Competency of ICAO for Integrated Airspace

As the post-Second World War oversight institution for the development of international air transport, ICAO was established by the Chicago Convention, which entered into force in 1947. The aim of the Convention was to provide safe and orderly international air transport by establishing certain principles and arrangements.[185]

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[179] Paul S. Dempsey & Maria Manoli, *Suborbital Flights and the Limitation of Air Space Vis-à-vis Outer Space: Functionalism, Spatialism, and State Sovereignty*, IAASS (Sept. 12, 2017), https://www.mcgill.ca/iasl/files/iasl/suborbital_flights_and_the_delimitation_of_air-outer_space.pdf.

[180] *See* Concept of Sub-Orbital Flights, *supra* note 99.

[181] *Id*.

[182] *Id*.

[183] ICAO Working Paper, *Safety Management Systems for Space Operations*, 13TH AIR NAVIGATION CONF (2018) https://www.icao.int/Meetings/anconf13/Documents/WP/wp_178_en.pdf [hereinafter ICAO WP 178]; *See also* JAKHU ET AL., *supra* note 51; Doucet, *supra* note 18, at 867.

[184] *See* RUWANTISSA ABEYRATNE, REGULATION OF COMMERCIAL SPACE TRANSPORT: THE ASTROCIZING OF ICAO 59-104 (2015).

[185] Chicago Convention, *supra* note 19.

The Chicago Convention emphasizes safety as of paramount importance in international civil aviation, as etched in its preamble: "having agreed on certain principles and arrangements in order that international civil aviation may be developed in a safe and orderly manner."[186]

Article 54 of the Convention authorizes the Council of the ICAO to adopt international SARPs and to designate them as Annexes to the Convention for the convenience of the contracting States.[187] Thus, in addition to the administrative functions that international organizations generally possess, the ICAO Council has a "quasi-legislative function."[188]

The 19 Annexes[189] contain SARPs regarding a range of areas, including safety and security of civil aviation, all of which have been developed by ICAO to establish a high degree of technical uniformity to develop civil aviation in a safe, efficient and orderly manner. The aims and objectives of ICAO are laid down in Article 44 of the Convention, of which the objective to "insure the safe and orderly growth of international aviation throughout the world" is still given the highest priority in the ICAO's work.[190]

The market growth for commercial space activities, coupled with the increasing usage of integrated airspace, highlight the importance of establishing worldwide safety standards. Air passengers are vulnerable in any situation that affects civil aviation safety. There is no doubt that aviation safety is a global concern that is directly linked to fundamental human rights, including the right to life.[191]

The ICAO has been exercising its "legislative-regulatory" functions since it was established. Moreover, the ICAO has been setting new standards or amending existing standards in response to developments in the civil aviation market, advanced technology and

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[186] *Id*.

[187] THOMAS BUERGENTAL, 7 PRINCIPLES OF PUBLIC INTERNATIONAL LAW 58 (1st ed. 1969).

[188] MICHAEL MILDE, INTERNATIONAL AIR LAW AND ICAO 149 (2d. ed. 2012).

[189] *ICAO Annexes and Doc Series*, SKYBRARY, https://skybrary.aero/articles/icao-annexes-and-doc-series (last visited May 20, 2023).

[190] *Global Aviation Safety Plan (2014-2016)*, ICAO, https://www.icao.int/NACC/Documents/Meetings/2014/RRSTGO/GlobalAviationSafetyPlan.pdf (last visited May 20, 2023).

[191] U.N.G.A. Res. 217 A(III)(1948), Universal Declaration of Human Rights, art. 3.

growth in aviation transport worldwide. Establishing worldwide uniformity in the application of safety standards is the main purpose of the ICAO work on SARPs.[192] In addition, as a competent authority to ensure safe and orderly growth of air transport, ICAO acknowledged the impact on safety and air traffic management of growing commercial space activities and suborbital launches already in 2015.[193]

B. ICAO's Position to Set Up Standards for Integrated Airspace Safety

Discussions among academics and institutions regarding the need to establish a governance system with standards for sustainable industrial operations for the space industry are ongoing. Commercial space activities within the integrated airspace undoubtedly require a regulatory system with harmonized standards.

Administering the *global* field requires collaboration and cooperation in the drafting and implementation stages of *global* regulations. Accordingly, the collaboration between governmental and non-governmental organizations is increasingly practiced as *global* governance. To be more precise, in order to promote civil aviation safety, ICAO has adopted a collaborative approach for all States as well as non-State actors.[194]

Although the private industry enjoys being "free" from cumbersome restrictions in commercial space activities, actors in this space will eventually agree that sustainable space commercial activities will thrive only if supported by strong international regulatory norms. Internationally agreed, effective standards will create a less complicated and clearer orbital debris business environment for commercial space operators.[195] The lack of a comprehensive regulatory system for integrated air space impacts commercial space activities. For instance, on June 29, 2021, a SpaceX rocket launch was cancelled due to the entrance of a helicopter into the restricted

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[192] Chicago Convention, *supra* note 19, art. 37.

[193] ICAO Working Paper, *Commercial Space Flights*, at 2.2, 36TH SESSION OF THE LEGAL COMM, (2015) https://www.icao.int/Meetings/LC36/Working%20Papers/LC%2036%20-%20WP%203-2.en.pdf.

[194] *2011 State of Global Aviation Safety*, ICAO, http://www.icao.int/safety/Documents/ICAO_State-of-Global-Safety_web_EN.pdf (last visited May 20, 2023).

[195] Larsen, *supra* note 116, at 749.

area for launch at the last moment.[196] After the incident, the founder and chief executive of SpaceX, Elon Musk, posted a statement on Twitter blaming the current regulatory system for the incident, calling it "broken."[197]

The worldwide activities of ICAO within civil aviation have been far greater than what was originally envisaged. The complexity of the work of ICAO has increased since it was established. More significantly, nowadays in addition to signatory States, ICAO enjoys input from private actors such as air companies and their representative bodies, like the International Air Transport Association (IATA)**,** other aviation stakeholders and other international organizations.

Accordingly, ICAO and UNOOSA have developed closed cooperation to ensure the seamless integration of aviation and space operations. As a result, in 2019, representatives of the aviation and space community, including the commercial and private sectors, came together for a series of symposiums to explore existing regulatory mechanisms and operational practices in aviation and space transportation in Vienna.[198]

During the 40th session of the General Assembly of ICAO (2019), the International Federation of Air Traffic Controllers' Association (IFATCA), the International Federation of Air Line Pilots' Associations (IFALPA) and IATA explained their concern about commercial space operations over international waters, which are not always based on ICAO-made standards, and the lack of harmonized procedures for air traffic controllers and notifications for airlines. In the process it was highlighted that the global perspective has not been considered, thus indicating that an increase in

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[196] Katie Canales, *SpaceX Had to Reschedule Its Rocket Launch Because a Helicopter Entered the 'Keep Out Zone' with Seconds to Go — and Elon Musk Isn't Happy About It,* BUS. INSIDER (June 29, 2021), https://www.businessinsider.com/elon-musk-spacex-launch-called-off-aircraft-keep-out-zone-2021-6.

[197] *See* @elonmusk, TWITTER (June 29, 2021, 2:06 PM), https://twitter.com/elonmusk/status/1409951549988782087.

[198] *See* Comm. on the Peaceful Uses of Outer Space Sixty-second Session, Cooperation between the United Nations Office for Outer Space Affairs and the International Civil Aviation Organization, A/AC.105/2019/CRP.14 (June 18, 2019), https://www.unoosa.org/res/oosadoc/data/documents/2019/aac_1052019crp/aac_1052019crp_14_0_html/AC105_2019_CRP14E.pdf.

collaboration with all stakeholders is essential.[199] Furthermore, ICAO was asked to initiate actions to address space operations and bring the industry partners to the level to develop their eventual integration.[200]

Accordingly, the ICAO General Assembly adopted a Resolution (A40-26) at its 40th Assembly with the aim of increasing collaboration and coordination with "[s]tates, governmental and non-governmental organizations, the private sector, academia and the relevant United Nations system entities to monitor the progress and evolution of commercial space transport and to address emerging issues, including the impact on international civil aviation operations."[201]

With that said, in June 2012, at the 8th meeting of the 196th Session of the ICAO Council,[202] the Council approved ICAO's revised Vision and Mission Statements. According to the revised Mission Statement, "the International Civil Organization is the global forum of States for International civil aviation. ICAO develops policies, standards, undertakes compliance audits, performs studies and analyses, provides assistance and builds aviation capacity through the cooperation of the Member States and stakeholders."[203]

Then, in 2022, at the 41st of General Assembly, ICAO adopted Resolution (A41-9). In this Resolution, ICAO underlines its role as a global forum "to facilitate improved cooperation, collaboration and the sharing of best practices in support of regional initiatives and to undertake the necessary follow-up activities that build on those initiatives by encouraging increased dialogue between States, New Entrants, existing aviation stakeholders and the space community."[204] However, it is arguable whether this is accurate according to the Chicago Convention. Under Article 44 of the Chicago Convention, the aim and objective of ICAO are namely defined as:

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[199] ICAO Working Paper, *Commercial Space Operations Integration*, ICAO GENERAL ASSEMBLY 40TH SESSION (2019), https://www.icao.int/Meetings/a40/Documents/WP/wp_126_en.pdf.

[200] *Id*.

[201] ICAO Resolution A40-26, Commercial Space Transport CST (2020), https://www.icao.int/Meetings/a40/Documents/Resolutions/a40_res_prov_en.pdf.

[202] ABEYRATNE, *supra* note 184, at 2.

[203] *Vision and Mission*, ICAO, https://www.icao.int/about-icao/Council/Pages/vision-and-mission.aspx (last visited May 20, 2023).

[204] ICAO Res. A41-9, *supra* note 111.

> …to develop the principles and techniques of international air navigation and to foster the planning and development of international air transport so as to:
>
> a) Ensure the safe and orderly growth of international civil aviation throughout the world…
>
> d) Meet the needs of the peoples of the world for safe, regular, efficient and economical air transport.[205]

With a view to adjusting to and accommodating contemporary challenges and to pursuing its core objective, to "ensure the safe and orderly growth of international civil aviation throughout the world," ICAO needs to have a more active, stronger institutional position than merely serving as a "global forum."[206]

ICAO could go further by providing a global forum to discuss and welcome all stakeholders to participate in the decision-making process regarding global standards *as well as* serving as a regulatory authority to make global decisions about the safety standards to pursue and to ensure uniformity in their worldwide implementation. Therefore, the ICAO should be addressed as a "global *regulatory* authority" and a global agency because both these functions enable the organization to pursue its objectives.[207] Nonetheless, describing ICAO as a "global regulatory authority" does not and should not refer to its hierarchical supremacism over the sovereign States.

C. Safety Management System for Integrated airspace within the ICAO

The immediate challenge starts with the legal definitions of activities, vehicles and other issues related to commercial space activities within the existing international regulatory structure as provided by the Chicago Convention and the "Chicago System." The idea of including space commercial activities by adding only an annex to the Chicago Convention would not be the ideal structure for

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[205] Chicago Convention, *supra* note 19, art. 44.

[206] Oliver Onidi, *A Critical Perspective on ICAO,* 33 AIR & SPACE L. 38, 40 (2008).

[207] *Id.* at 43 (stating that "ICAO should be worldwide technical rule making body, setting relevant international standards while ensuring their effective and uniform application. In time ICAO could effectively become the 'world regulatory authority'.").

a very complex operation.[208] The complexity is that such a safety management system in the integrated airspace arises from technical differences and different safety standards of air and space operations.[209]

However, the Safety Management System for integrated airspace traffic within ICAO can be considered by establishing a new *division* that would work on the collaboration of air and space operations. The integrated airspace management policies will regard commercial space and other operators as users and create policies to serve the competing interests of all users within the airspace.[210]

For instance, the US model suggests a structure that places space-related regulation within the authority responsible for aviation matters.[211] The Office of Commercial Space Transportation was established in 1984 as part of the Office of the US Secretary of Transportation within the Department of Transportation (DOT). The Office was transferred to the FAA in November 1995.[212]

Considering different levels of target safety, the US FAA created an alternative approach named acceptable level of risk.[213] It is the temporary way for the Air Traffic Organization to manage airspace where space launch or re-entry occurs that applies safety principles of both industries until the technology develops with capabilities to manage the airspace safety system.[214]

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[208] *See* ABEYRATNE, *supra* note 184.

[209] ICAO Working Paper, *Integrating Public Safety Standards for Commercial Space and Aviation*, 13th Air Navigation Conf. (2018), https://www.icao.int/Meetings/anconf13/Documents/WP/wp_205_en.pdf.

[210] Ruth E. Stilwell, *Blurring the Lines: The Overlapping Interests of High Altitude Unmanned Aircraft*, SPACE TRAFFIC MGMT. CONF. (Dec. 11, 2015), https://commons.erau.edu/cgi/viewcontent.cgi?article=1077&context=stm.

[211] *About the Office of Commercial Space Transportation*, FED. AVIATION ADMIN., https://www.faa.gov/about/office_org/headquarters_offices/ast__(last visited May 20, 2023).

[212] *Id*.

[213] ABEYRATNE, *supra* note 181 ("the application of an intermediate adjustment in individual risk; operational restrictions; and a new collective risk limit. Together, these elements are the basis of the ALR approach.").

[214] ALPA 2019, *supra* note 40, at 11 ("we see a strong connection between the technology that can be employed to safely improve efficiency in oceanic airspace and the use of that technology to reduce the impact of spaceflight on commercial air traffic. More accurate and frequent data exchange, ATC automation improvements, surveillance, and real-time voice and data communications will aid pilots in safely conducting operations.").

Commercial air and space transport industries are growing with unprecedented technological visionary developments. The advanced technology in space operations also predicts new-generation vehicles with flight types within the airspace. Hence, the regulatory policies that are developed by the authorities also require engagement with the industry. For instance, the Commercial Space Integration into the National Airspace System (CSINAS) Concept of Operations was developed to provide a strategy for more efficient and predictable operations for all airspace users through improved planning, and situational awareness among stakeholders by the US FAA, with the collaborative effort of multiple organizations, including the Office of NextGen (ANG), the Office of Commercial Space (AST), the Air Traffic Organization (ATO) and the Office of Airports (ARP).[215]

The operational experience of the US and immediate structural responses taken to manage integrated airspace can be considered a model for the ICAO. While establishing a globally integrated airspace safety management system including both industries, the operational and technical differences and safety risks should be considered carefully to achieve a balanced management system.[216] It will be essential that the policies shaping the regulatory framework for the safety of operations within the integrated airspace consider both industries' interests. The regulatory policies and related standards within the airspace require engagement with both air and space industries. The participation of the commercial space industry in establishing harmonized standards for integrated airspace will contribute to and guide the creation of a safer environment for both air and space users.[217]

VII. CONCLUSION

Governing global civil aviation safety requires joint efforts of the world community of States as well as less traditional actors (non-State actors) operating within the same sector. With the changes in many aspects of our daily life in the current digital era,

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[215] US FED. AVIATION ADMIN., COMMERCIAL SPACE INTEGRATION INTO THE NATIONAL AIRSPACE SYSTEM: CONCEPT OF OPERATIONS (2020), https://www.faa.gov/sites/faa.gov/files/space/airspace_integration/Final_CSINAS_ConOps.pdf.

[216] ABEYRATNE, *supra* note 184, at 4-5.

[217] Rendleman, s*upra* note 117, at 749.

notably as advanced technology produces increasing commercial air and space activities, the law regulating life can hardly remain static. Global developments are putting pressure on necessary reformations of global regulations. One of the shared common values of global society in a contemporary world is civil aviation safety. As increasing global challenges and threats are beyond the individual States' capacity to regulate, the law should be developed to enhance the global normative system for civil aviation safety.

In line with global market developments in civil aviation, such as the growth in air traffic, air transport market liberalization, the use of new and advanced technologies, regional integrations in the governance of civil aviation and the Covid-19 pandemic that resulted in a decrease globally in air operations, taken together demonstrate that there is a need for a reform of the Chicago Convention and to revisit and revise the global role and functions of the ICAO.[218] Together with growing number and frequency of space activities and booming commercial space operations in general, the governing of the safety of shared airspace within the current system, if the status quo is maintained, will become more complicated.

Considering the ineffectiveness of responding to contemporary issues, both the Chicago Convention and the Outer Space Treaty are "outdated." The current system of global aviation safety needs to be adjusted to address contemporary global air and space market developments. It is not realistic, however, to expect such a legal regime to deal with the growing commercial space operations can be achieved so soon; States must agree, they tend not to! Although the need for a legal regime is obvious, the politics and political will in the world community is not always willing to be guided in this often unregulated, yet most profitable, space business.[219]

In any case, the safety problem within the integrated airspace is immediate, and there is no room to waste more time. Rapid

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[218] *See also* BRIAN HAVEL, BEYOND OPEN SKIES: A NEW REGIME FOR INTERNATIONAL AVIATION *(*2009); Onidi, supra note 206; Ruwantissa Abeyratne, *The Role of the International Civil Aviation Organization (ICAO) in the Twenty First Century,* 34 ANNALS AIR & SPACE L. 529 (2009).

[219] *See also* Kai-Uwe Schrogl, *Space Law and Diplomacy*, 59 PROC. INT'L SPACE L. 3, 9 (2016), https://www.elevenjournals.com/tijdschrift/iisl/2016/1%208th%20Nandasiri%20Jasentuliyana%20Keynote%20Lecture%20on%20Space%20Law%20&%20Young%20Scholars%20Session/IISL_2016_059_001_001.

improvements in safety governance in integrated airspace must be established within the current legal regime of the Chicago Convention by establishing a collaborative approach that includes both industries.

The Chicago System has long been established as a global governance system for aviation safety with efficient services and should be a suitable establishment with which to start. Considering the dynamics of life and advanced technology, the global aviation safety governance system of ICAO should include space activities in integrated airspace. Moreover, ICAO should take more leading role as a "regulatory authority" with the aim and objective defined by Article 44 of the Chicago Convention so as to ensure safe and orderly growth of international civil aviation and to regulate air and space activities in the global integrated airspace.