ISSN 2394-6091

Indian Journal of Air and Space Law (IJASL)

A Bi-annual Journal published by Centre for Aerospace & Defence Laws (CADL), NALSAR University of Law, Hyderabad.

Volume XII

December 2021

CENTRE FOR AEROSPACE AND DEFENCE LAWS (CADL)
NALSAR UNIVERSITY OF LAW, HYDERABAD

ISSN 2394-6091

Indian Journal of Air and Space Law (IJASL)

Volume XII December 2021

COPYRIGHT POLICY

CITATION FORMAT

[VOLUME IJASL[PAGE] ([YEAR])
ISSN 2394-6091

TABLE OF CONTENTS

EDITORIAL

Centre for Aerospace and Defence Laws (CADL), NALSAR, as an institution stands for par excellence research and through its courses, journals, newsletters, moot courts, conferences and other activities, bringing the attention of the Aerospace and Defence community to forefront and highlighting its contemporary issues and challenges at a global level.

The *Indian Journal of Air and Space Law (IJASL)*, an exclusive and vital part of the CADL, is inclusive of articles from authors, scholars, and students across the world. This area of study draws its relevance on various specialties: each of which is undergoing doctrinal and practical transformation as a result of new and emerging contemporary developments. This Journal was conceived with the intention to highlight recent developments, relate them to theoretical issues and critically analyse their implications. It caters to a broad spectrum of audience such as students interested in the field of international aerospace and defence laws, practicing lawyers, judges, research scholars and for all the other interested professionals.

It gives me an immense pleasure and enthral to release the special Issue, Volume XII, of *Indian Journal of Air and Space Law*. I am thankful and grateful to all those who have contributed their research work in the field of Aerospace Laws. This issue of the Journal contains many contentious themes pertaining to the sphere of Air and Space Laws such as: Environmental concerns in Space Debris Management, Space Mining, Ethical and Legal Issues in Space Medicine, Policy Frameworks for eVTOLS, Privatization and Commercialization in Indian and Global Space Sector, Booking issues in Aviation, Legal and Policy Aspects in Aerospace Sector, Liability in Space Collision etc.

Advancement and implementation of ever-evolving aerospace technology has resulted in tremendous global impact to diversify the field on numerous levels and calls for a further heated debate and research in this field. Nevertheless, apart from the academic and practical point of view, such interest for increasing need for exploration and uses of outer space can also be seen through scientific thriller movies, books and illustrations as well.

With the augmentation of globalization, intermingling and interdependence of economies, liberalization of space policies, technological developments in aerospace industry, privatization of certain aerospace segments, and the growing trends in non-interventionist bilateral and multilateral agreements, there is a development of new trends that are emerging in the aerospace industries throughout the world. Privatization and intensified global competition are forcing the aviation and space industries to become responsive, increasingly competitive and committed by focusing more closely on their stake-holders.

The recent venture of the Indian space agency ISRO to explore the surface of Mars is one instance which shows that the Indian aerospace technology is fast evolving, in response to the development happening elsewhere. While, India has accomplished international acclaim in the area of aerospace technology development and utilization, there is still the need for integration for efforts at the national level, from the standpoint of the private sector. Nevertheless, it is an undeniable fact that the Indian Aviation sector is still in need for reformation in terms of liability, compensation and regulation of competition. At the same time, military missiles and satellites technology requires at par development with the International standards, in an effective and efficient manner as opposed to purchasing the same from other

states at an exorbitant price. Therefore, the efforts of this Journal would be to promote and encourage a healthy and innovative debate on all facets of aerospace industry and ensure that the ethical standards of research are complied with.

The publication of IJASL is only possible with the relentless effort put in by **Prof. Faizan Mustafa-Vice-Chancellor, NALSAR University** and his constant, unequivocal and fortifying support coupled with his exemplary leadership, pleasing personality and brilliant administrative skills that have been a source of inspiration for us. He has continuously and regularly steered the academic path to evolve avenues for research and publication and attain higher levels of excellence.

I, on the behalf of the Editorial Team, profoundly and gratuitously thank our Patron for bestowing his faith in our ability to publish this Journal. I extend our gratitude to our National and International advisory board, whose valued suggestions and advice has guided the Journal in every aspect.

The Journal is our modest venture in further and advance research in the field of aviation and space law, and we at Centre for Aerospace and Defence Laws, sincerely hope, to keep up with our efforts for the continuation of the Journal.

I also sincerely hope that you enjoy reading this Issue as much as we enjoyed working on it.

Dr. V. Balakista Reddy
Editor-in-Chief

CENTRE FOR AEROSPACE AND DEFENCE LAW (CADL)

The NALSAR University of Law has always endeavored to promote quality research in contemporary legal issues. One of the contemporary but neglected areas in the Indian legal realm is Air and Space laws. To fill this gap and to promote further studies and research in the aerospace law, the University established the advanced Centre for Aerospace and Defence Laws (CADL) in 2005 with object to contribute to the development of aviation and space laws and related policies by conducting and promoting research and teaching at different levels. Since then, NALSAR-CADL has been continually promoting the study of Air and Space Law by conducting National and International Conferences, Workshops and Publishing Newsletters, Books and Articles in the Aerospace law field.

The University has been teaching the subjects of air and space law for the past ten years. Till date, there are many students with degrees in air and space law who have now been absorbed in the national mainstream and are working with the airlines, airports and the multinational corporations. Recently, NALSAR-CADL has also launched few innovative On-site and Online courses which include the Two-Year Master's Degree in Aviation Law and Air Transport Management (MA ALATM); Two-Year Master's Degree in Space and Telecommunication Laws (MA STL); Two-year Master's Degree in Security and Defence Laws (MA SDL); Two-Year Master's in Maritime Laws; One-Year Advanced

Diploma in Aviation Law and Air Transport Management; One-Year Advanced Diploma in Maritime Laws and One-Year Advanced Diploma in GIS & Remote Sensing Laws. The objectives of these courses are to cater to the needs of unprecedented aviation growth coupled with commercialization of space and telecom industries, and moderinisation and indigenisation of defence and maritime Industry, which calls for thousands of skilled manpower to meet the managerial requirements of rapidly growing airports, airlines, aerospace, defence, shipping and telecommunication sectors. CADL also undertakes collaborative research activities in areas of common concern with state governments, NGO's and other international organizations.

A NOTE FROM THE FOUNDER OF THE ESSAY COMPETITION

2nd DR. APJ ABDUL KALAM AIR AND SPACE LAW AND POLICY ESSAY COMPETITION

As Founder and Editor-in-Chief of the Essay Competition, I am delighted to share with you that the second edition of the essay competition received 75 submissions from students and professionals around the globe. Out of the submissions received, the selected top 10 essay entries are printed in this volume of the Indian Journal of Air and Space Law published by Centre for Aerospace and Defence Laws (CADL), NALSAR University of Law, Hyderabad. In addition to the publication in the journal, a cash prize of Fifty Thousand Rupees (approx., USD 800) will be announced and awarded to the recipients at the International Legal and Policy Conference on The Future of Transport – Fall or Rise of the Transport Sector, on 27-28 December 2021.

The objective of this annual essay competition is to offer insight into pertinent issues and challenges, offering potential solutions and analyses from professionals and experts in the fields of air and space law. Moreover, these insights demonstrate the global nature of air and space activities, and how current and future challenges require a progressive approach in the development and application of law and policy. This collection of essays, addressing the contemporary issues and future challenges in air and space law,

provides a valuable resource for experienced practitioners and students. By delving past headlines and buzzwords to explore current and future challenges and solutions, these essays present a rigorous legal examination relevant to the missions and efforts of international and regional organisations, civil aviation professionals, international and national space agencies, private operators, investors, insurers, and aviation and space consultancies.

I wish we continue to do this essay competition in years to come and that through this initiative my goal to find some ideas and supporting jurisprudence through this exercise will benefit the aviation and space community. My sincere thanks once again to Centre for Aerospace and Defence Laws (CADL), NALSAR University of Law and Lex Erudites for the support, the guidance and for the belief that these essays will contribute for the betterment of the future industry.

I sincerely thank the jury members who not only supported the initiative but have taken valuable time from their busy schedule to review the essay entries. Following are the jury members of the 2nd Dr. APJ Abdul Kalam Air and Space Law and Policy Essay Competition 2021:

1. Prof. Faizanur Rehman
2. Prof. Balakista Reddy
3. Sagar Singamsetty
4. Adv Akhil George

5. Adv Gajendra Singh Rajpurohit
6. Sivadath Madhu Menon
7. N Arun Vaidyanath
8. Amritha Navada
9. Lakshmi Nandana
10. Eilin Maria Baiju
11. Karthik M Menon
12. Mrinal Rajendran
13. Johan Manoj Mathew
14. Shreya Subramanian

Sagar Singamsetty
Founder and Editor-in-Chief
Dr. APJ Abdul Kalam Air and Space Law and Policy Essay Competition

THE HITCHHIKER'S GUIDE TO THE ENVIRONMENTAL CONCERNS IN THE GALAXY: AN INDIAN PERSPECTIVE ON SPACE DEBRIS MANAGEMENT

Isha Choudhury

Global Approaches to Space Waste Generation: An Introduction

India's foray into space has been one of its greatest triumphs. The space race has seen countries pitting against each other to launch the first satellite to be the first to reach the moon. India has not ceased to follow suit with the world leaders like China, the USA, and Russia, but it has its consequences. The United States is the largest space polluter followed by Russia and China. Perhaps, active satellites form a very small portion of manmade items in space[1]. Increasing technological advancement and human presence in space, has resulted in enormous space junk. Recently, India grabbed the international limelight for generating 400 pieces of space debris[2]. Space is gradually becoming a replica of the Pacific ring of garbage. Broken and inactive satellites, human faecal matter, astronaut tools, and gear, are the most common form of space debris that is spotted. This junk can stay up for more than a hundred years and moves ten times faster than a speeding bullet.

As space expeditions increased in the 1990s, the space debris also grew exponentially by 25%[3]. An increasing amount of space debris

---

1 Dave Mosher, *These are the countries on Earth with the most junk in space*, BUSINESS INSIDER (October 21, 2017, 02:00 IST), https://www.businessinsider.in/tech/these-are-the-countries-on-earth-with-the-most-junk-in-space/articleshow/61158510.cms

2 PTI, *India's shooting down of satellite created 400 pieces of debris, put ISS at risk: NASA*, THE ECONOMIC TIMES (April 02, 2019), https://economictimes.indiatimes.com/news/defence/indias-shooting-down-of-satellite-created-400-pieces-of-debris-put-iss-at-risk-nasa/articleshow/68682165.cms

3 *The Growth of Space Debris*, UNION OF CONCERNED SCIENTISTS (January 31,2009), https://ucsusa.org/resources/growth-space-

poses a danger to the active satellites in space. A simple scientific understanding of satellites is based around gravity. Hence, when a satellite ventures the space around Earth it orbits the planet and transmits various signals. Eventually, gravity pulls a satellite back into the Earth's atmosphere. However, the atmosphere makes it difficult for the satellite to reach back, and they usually burn up before entering Earth. The debris generated by the satellite blast usually falls on Earth. Sputnik I was the first satellite to orbit Earth. It successfully orbited Earth for three months, before re-entering the atmosphere and burning up[4]. While, there are plenty of inactive satellites that haven't orbited back, and remain up there. Satellite collisions grabbed headlines back in 2009 when the Iridium 33 collided with the inactive Russian satellite Cosmos 2251. This resulted in a large debris cloud, with more than 1600 fragments being documented. By 2030, around 70% of this debris generated will descend through the orbit of the International Space Station but 20% will remain in the orbit for thirty years.

NASA Scientist Donald J. Kessler proposed the Kessler Syndrome theory, which is based on the cascading effect. It is a scenario where the density of objects in the low earth orbit is high enough that collisions between objects create more debris, which increases the likelihood of more collisions[5]. As the number of satellites in the orbit increases, the incidence of collisions becomes more apparent.

---

debris#:~:text=Space%20debris%20has%20been%20increasing,a%20growing%20threat%20to%20satellites.

4 Ethan Siegal, *This is why Sputnik crashed back to Earth after only 3 months, FORBES, (November 15, 2008, 10:00 AM EST)* https://www.forbes.com/sites/startswithabang/2018/11/15/this-is-why-sputnik-crashed-back-to-earth-after-only-3-months/

5 Louis de Gouyon Matignon, *The Kessler Syndrome, SPACE LEGAL ISSUES (March 27, 2019)* https://www.spacelegalissues.com/space-law-the-kessler-syndrome/

The advent of Anti Satellite Missions (A-SAT) has also added to the generation of space debris. The United States and Russia have been pioneers in anti-satellite missions. These are technically space weapons that are designed to incapacitate the satellites for strategic purposes. Till now, only four countries have successfully conducted A-SAT tests, with India becoming the fourth one in 2019[6]. A-SATs have been identified as a powerful weapon towards space warfare, however, no country has used it yet. However, the use of A-SAT poses a risk of creating huge volumes of space debris. Between 1968 and 1985, both the USA and Russia conducted ASAT tests, which documented 7% of the orbital debris by 1990. As China followed suit in 2007, by launching a ballistic missile for destroying a Chinese weather satellite, it subsequently produced 3000 pieces of space debris[7]. While India attained breakthrough success in joining the A-SAT league in 2019 through its Mission Shakti. Similar operations have proved to produce an extravagant amount of space debris that hasn't decayed while entering the atmosphere. As more countries aspire to conduct tests of similar nature, the probability of space collisions has increased.

Various countries have taken a serious step towards tracking the debris that has been so generated, but this comes with limitations. While bigger objects are easier to track, smaller particles usually escape the trackers and remain unidentified. The British satellite, RemoveDEBRIS is an ambitious mission towards removing 40,000 pieces of space debris that are orbiting the Earth. It is equipped with

---

6 Business Insider, *What is an ASAT and how can it be used in war?, BUSINESS TODAY, (March 27, 2019)* https://www.businesstoday.in/current/economy-politics/what-is-an-asat-pm-narendra-modi-space-missile/story/331585.html

7 Lorreta Hall, *The History of Space Debris, EMBRY-RIDDLE AERONAUTICAL UNIVERSITY, (November 6th, 2014)* https://commons.erau.edu/cgi/viewcontent.cgi?article=1000&context=stm

a standard satellite called CubeSat, which uses a net technology to capture space debris[8]. Even though the space junk doesn't pose a serious problem to exploration odysseys, but puts the active satellites at risk of damage. Since 1999, The International Space Station has carried out 25 collision avoidance manoeuvres to avoid space junk damage. The ISS and NASA have been proactive towards Space Situational Awareness in the United States. The U.S. Strategic Command (USSTRATCOM) uses the SSN to track the largest object in the Earth's orbit along with additional radars, telescopes, and in-situ measurements to characterize minute objects. As the smallest of the orbital debris poses the highest penetration risk, in-situ measurements are the most effective means to collect measurements. To address the problem of millimeter-sized debris above 600 km, NASA developed an in situ measurement instrument – the Space Debris Sensor (SDS)[9].

Space debris production has indeed garnered a lot of international attention, but there still exists a vacuum towards clearing the space debris through international cooperation. As satellites are of both defence and strategic importance, every country has to devise its plan to tackle the debris generated by them. Currently, there is no binding treaty that exists to regulate space debris management. As the world technologically advances, with companies like SpaceX and Amazon reaching for the stars to achieve universal satellite internet coverage. These endeavours will launch an additional

---

8 Loren Grush, *Satellite uses giant net to practice capturing space junk*, THE VERGE (September 19, 2018) https://www.theverge.com/2018/9/19/17878218/space-junk-remove-debris-net-harpoon-collisions

9 J.C. Liou, *U.S. Space Debris Environment, Operations, and Research Updates*, NASA, (29 January, 2018) https://www.unoosa.org/documents/pdf/copuos/stsc/2018/tech-14E.pdf

50,000 satellites in the orbit, with minimal regulation on the waste generated and an increased probability of collisions[10].

India's Policy on Space Waste: A Critique of Mission Shakti and Project NETRA

An accumulation of space debris around the Earth's orbit creates an obstacle for new missions. As the pathways may get blockages, it may delay missile and rocket launches. In June 2014, an Indian rocket carrying satellites from four countries faced a three-minute delay due to space debris[11]. Similarly, the International Space Station constantly dodges the smaller particles of the debris generated. India recently contributed its share to the space debris through its ambitious Mission Shakti.

India became the fourth country to successfully conduct an anti-satellite test, which put India as a global space power. Mission Shakti had successfully destroyed a satellite located 3000 miles away, but this grabbed negative publicity in the international media for producing 400 pieces of space debris. NASA criticized the Mission Shakti by citing the 44% raise in danger to the International Space Station. The DRDO fiercely backed Mission Shakti to be a responsible mission, by proclaiming the nature of the missile to be in the lower atmosphere. Hence, the amount of debris that was generated was said to be decaying, posing no harm. Although there

---

[10] Jonathan O'Callaghan, *What is Space Junk and why is it a problem?,* NATIONAL HISTORY MUSEUM, https://www.nhm.ac.uk/discover/what-is-space-junk-and-why-is-it-a-problem.html#:~:text=Space%20junk%2C%20or%20space%20debris,have%20fallen%20off%20a%20rocket.

[11] *India Rocket Launch Delayed Three Minutes to Avoid Space Debris,* NDTV, (June 27, 2014) http://www.ndtv.com/article/india/indian-rocket-launch-delayed-three-minutes-to-avoid-space-de bris-549160.

is no way of ascertaining that the debris produced has been contained[12].

The major objective behind conducting the test was to validate India's capability to safeguard space assets and accelerate space development programs. Yet, this hasn't gone down well with other developing countries and international media. Mission Shakti has increased the speculation of India entering into an arms race in the space, which India has denied. The weaponization of outer space and space warfare is another looming concern, as it directs towards an increased generation of space debris. Although India supports UNGA resolution 69/32 on No First Place of Weapons on Outer Space and Prevention of an Arms Race in Outer Space (PAROS)[13]. This ensures that legal measures are undertaken towards the prevention of the arms race.

There is a crucial need to change the narrative that is being utilized towards India's space endeavours. We have indeed put ourselves up globally through Mangalyaan and Mission Shakti, but applying a conservationist approach is equally important. In 2019, The Indian Space Research Organization (ISRO) successfully initiated Project NETRA (Network for space object Tracking and Analysis), which will give India its own Space Situational Awareness (SSA) identical to the ones with other developed countries like the USA and Russia. SSA will help India navigate and predict threats due to the debris,

---

[12] S.S. Jeevan, *Space Race 2.0: Orbit of Debris,* DOWN TO EARTH, (March 12, 2019) https://www.downtoearth.org.in/blog/science-technology/space-race-2-0-orbits-of-debris-64265

[13] *Frequently Asked Questions on Mission Shakti, India's Anti Satellite Missile Test conducted on March 27, 2019,* MINISTRY OF EXTERNAL AFFAIRS, (March 27, 2019) https://www.mea.gov.in/press-releases.htm?dtl/31179/Frequently_Asked_Questions_on_Mission_Shakti_Indias_AntiSatellite_Missile_test_conducted_on_27_March_2019

and safeguard the satellites. As India has 15 communication satellites, 13 remote sensing satellites in the lower orbit, 8 navigation satellites in the medium-earth orbit, and other smaller satellites, these assets will be protected by the SSA[14]. Project NETRA is an ambitious venture towards the protection of space assets, but it doesn't concentrate on the mitigation of the space debris generated. The eventual goal for the project is to capture the geostationary object, seen at 36,000 kilometers which is the operational hub for communication satellites[15]. Hence, it would be safe to say, the Project NETRA does little to curb the space waste, and simply navigates the waste for successful project launches.

As the SSA became an integral part of space operations, ISRO dedicated its efforts to make it a huge success. The North America Aerospace Defence Command (NORAD) was responsible for monitoring the Indian space debris[16]. Charting a pathway towards 'Atmanirbhar Bharat', in 2020, the ISRO SSA Control Centre was formally inaugurated. The SSA Control Centre is responsible for carrying out the core SSA activities along with dedicated labs for Space Debris mitigation and remediation[17]. As space gets more populated, precise data on space debris is important to minimize it.

---

[14] *Project NETRA*, JOURNALS OF INDIA, (April 22, 2020) https://journalsofindia.com/project-netra/

[15] *ISRO's Project NETRA to help detect space hazards to Indian satellites,* MONEYCONTROL, (September 24, 2019) https://www.moneycontrol.com/news/india/isros-project-netra-to-help-detect-space-hazards-to-indian-satellites-4470841.html

[16] Prabhjote Gill, *India doesn't trust US with measuring space debris – and so it will set up its own agency,* BUSINESS INSIDER, (August 06, 2019) https://www.businessinsider.in/isro-to-set-up-own-space-debris-agency-because-norad-data-inaccurate/articleshow/70550082.cms

[17] *ISRO SSA Control Centre inaugurated by Dr. K Sivan, Chairman ISRO/ Secretary DOS*, ISRO, (December 16, 2020) https://www.isro.gov.in/update/16-dec-2020/isro-ssacontrol-centre-inaugurated-dr-k-sivan-chairman-isro-secretary-dos

India has been an active member of the Inter-Agency Space Debris Coordination Committee (IADC) which researches debris elimination, spacecraft shielding, and threats from larger constellations. ISRO has taken several measures with IADC and United Nations Space Debris Mitigation Guidelines. The Directorate of Space Situational Awareness and Management at ISRO is working towards implementing strategies for situational awareness and supporting infrastructure for protecting the Indian space assets. Although serious attention has to be given to the dynamic nature of the space. A large number of constellations are being developed in the low Earth orbit, which poses a threat to the traditional satellite. As many of these constellations consist of nano and smaller satellites, which don't consist of a manoeuvring system to alter their orbit. These pose a threat to space debris generation, making it further complicated and increases the incidence of collisions[18]. ISRO has to take a mindful approach towards space debris management, and not limit it to a navigational purpose.

Scientific and Community Involvement towards Space Waste Management: Efforts by Digantra

Under the purview of International law, incidences of collisions are covered under the 1967 Outer Space Treaty and the 1972 Liability Convention. Hence, the 'Launching State' is responsible for the objects present in the orbit. The Liability Convention dictates that the fault must be determined on the occurrence of damage. Although

[18] *Research on space debris, safety of space objects with nuclear power sources on board and problems relating to their collision with space debris,* UNITED NATIONS GENERAL ASSEMBLY, (November 23, 2020) https://www.unoosa.org/oosa/en/ourwork/topics/space-debris/index.html#:~:text=The%20United%20Nations%20Committee%20on,the%20creation%20of%20space%20debris.&text=One%20important%20result%20of%20those,the%20General%20Assembly%20in%202007.

no liability convention has been invoked yet under the convention[19]. The Indian Space Policy doesn't talk directly on the issues on the threat of space waste, it is designed to chart pathways to becoming a space power. A developmental and technologically advanced methodology has been employed to scale greater heights. The current guidelines by the Inter-Agency Space Debris Coordination Committee (IADC), governing the debris mitigation programs are inept[20]. Considering that India recognized space debris as a huge problem back in 2003, during the 21st meeting of the IADC[21]. The policy framework remains defunct towards tackling space junk. However, India can spearhead the formulation of a long-term roadmap with a multi-disciplinary collaborative approach towards strategic investments that will contribute to scientific advancement.

The scientific communities and various private organizations have also recognized the need for developing a proactive approach towards curbing space debris. Digantra Research and Technology (DRT), is a space start-up founded in 2018 which is India's first air and space surveillance company. It has been successful in developing India's first in-orbit Space Debris Monitoring and Tracking System[22]. The efforts by DRT are no less than

---

[19] Brian Weeden, *2009 Iridium Cosmos Collision Fact Sheet,* SECURE WORLD FOUNDATION, (November 10, 2010) https://swfound.org/media/6575/swf_iridium_cosmos_collision_fact_sheet_updated_2012.pdf

[20] Rajeswari Pillai Rajagopalan & Narayan Prasad, *Space India 2.0 Commerce, Policy, Security and Governance Perspectives,* OBSERVER RESEARCH FOUNDATION (2017) https://www.orfonline.org/wp-content/uploads/2017/02/ORF_Space-India-2.0_NEW-21Nov.pdf

[21] *International Meet on Space Debris Held in Bangalore,* ISRO, (March 13, 2003) https://www.isro.gov.in/update/13-mar-2003/international-meet-space-debris-held-bangalore

[22] *Space start-up develops India's first in-orbit space debris monitoring, tracking system: Anirudh Sharma, Co-founder and CEO of Digantara,* SOCIETY FOR INNOVATION AND DEVELOPMENT, https://sid.iisc.ac.in/2020/08/19/space-startup-develops-

revolutionary as they provide real-time earth coverage through the deployment of cost-effective nanosatellites in the Low Earth Orbit. DRT aims to increase the public-private partnership in the Indian space sector, undertake more space missions, and securing space assets. NASA is evolving itself constantly by opening to an increasing number of private players through opening the International Space Station to private astronauts[23].

Digantra has developed the Orbit Space Debris Monitor which is an amalgamation of hardware and software. The hardware has a flight space-based laser and sensor system which tackles debris smaller than 5cm. While the software diligently collects raw data from the hardware stack and processes a debris map for operational support. This provides a defined course for manoeuvring satellites and avoiding debris. These Orbit Space Debris Monitors can provide information on real-time proximity alerts. DRT has been approved as an MSME, backed by the Indian Institute of Sciences, Bengaluru – Centre of Excellence. Successful collaboration with the Ecuadorian Space Agency (EXA) and expertise from Dr. TGK Murthy, ex program director of ISRO has added to the scientific understanding of the founders of DRT[24].

Space has been identified as a large playing ground for business. Shifting ownership and operations usually result in cost-effectiveness and technological advancements. India is famous for

indias-first-in-orbit-space-debris-monitoring-tracking-system-anirudh-sharma-co-founder-and-ceo-of-digantara/

[23] Michael Sheetz, *How NASA is evolving through partnerships with private space companies*, CNBC, (November 30, 2009) https://www.cnbc.com/2019/11/30/how-nasa-is-evolving-through-partnerships-with-private-space-companies.html

[24] Krishna Reddy, *How a bootstrapped space-tech start-up monitors space debris with its system to enable a collision free path*, YOURSTORY, (September 06, 2019) https://yourstory.com/2019/09/digantara-research-and-technology-nasa-space-debris-satellite-isro

cost-effective space endeavours along with a booming start-up culture. NASA has been pivotal in partnerships with various private organizations for supporting space technologies, a model that can be employed similarly in India as well. The International Space Station National Laboratory is a prime example of a public-private space partnership that has encouraged a plethora of researchers, entrepreneurs, and innovators alike[25].

The global space industry is estimated to grow by 5.6% to reach a whopping $558 billion by 2026[26]. ISRO has recognized the potential of the private players in the space market. In May 2020, ISRO invited various proposals by start-ups for solutions related to amenities for astronauts, green engines, and better tools for Gaganyaan-1. ISRO along with Larson & Toubro and Hindustan Aeronautics Limited is working towards building its polar satellite launch vehicle (PSLV). However, the highlight towards the management of space waste remains negligible. In June 2020, the Union Cabinet announced the formation of an extension for ISRO, called the Indian National Space Promotion and Authorisation Centre (IN-SPACe)[27]. As a nodal body, it will play a pivotal role in private player participation. However, policy gaps need to be scrutinized thoroughly for increasing partnerships. Lacunas in frequency allocation, approvals, and licenses for satellites by private companies are yet to be tackled by framed legislation.

---

[25] *Public-private partnerships in space*, CENTRE FOR ADVANCEMENT OF SCIENCE IN SPACE, https://www.issnationallab.org/research-on-the-iss/public-private-partnerships-in-space/

[26] *Global Space Industry Dynamics*, BRYCE SPACE AND TECHNOLOGY, LLC, https://www.industry.gov.au/sites/default/files/2019-03/global_space_industry_dynamics_-_research_paper.pdf

[27] Shreya Ganguly, *Can public-private partnership open a new frontier for Indian space tech*, YOURSTORY, (August 30, 2020) https://yourstory.com/2020/08/public-private-partnership-spacetech-isro

United States' Endeavour Towards Space Debris Management: Perspective of the Greatest Space Polluter

In February 2009, Cosmos 2251 an inactive Russian satellite collided with an active communication satellite-based in the United States, Iridium. This collision alone produced 2000 pieces of debris, which will remain in the orbit for decades. This incident alarmed the countries about the possible harms that space debris poses to the active satellites. The United States of America is not only a space superpower but also a leading producer of space debris with 4037 pieces of debris in space. Russia is not far too behind, with 4035 pieces orbiting the earth[28].

The U.S. Space Command tracked, only 3200 out of the 25000 objects in space are active satellites[29]. The Space Policy Directive-3 (SPD-3), titled 'National Space Traffic Management Policy' had identified the growing threat to space activities from the orbital debris. It directed NASA and allied bodies to update the U.S. Government Orbital Debris Mitigation Standard Practices (ODMSP) and formulate fresh operational guidelines for satellite design. In 2019, the updated ODMSP was issued which was originally established in 2001. These new guidelines aim towards the improvement of the initial guidelines along with devising standard practices for space operations. While the NASA Orbital Debris Program Office plays a nodal role in the maintenance and

---

[28] Phoebe Weston, *The countries with the most space junk revealed! Infographic shows the worst offenders when it comes to leaving debris in orbit',* DAILYMAIL UK, (November 27, 2018, 16:59 GMT) https://www.dailymail.co.uk/sciencetech/article-6434277/The-countries-space-junk-REVEALED-Infographic-shows-worst-offenders.html

[29] Sandra Erwin, *U.S. Space Command announces improvements in space debris tracking*, SPACE NEWS, (September 24, 2020) https://spacenews.com/u-s-space-command-announces-improvements-in-space-debris-tracking/

development of software modelling tools to assist the debris mitigation[30]. The updated policies and NASA interventions mostly fall short of dealing with the new challenges.

A '25 year rule' has been devised, which ensures that satellites and the debris generated don't remain in orbit for more than 25 years from the end of the mission. There was a serious backlash on the timeline, towards limiting it especially for satellites on a mission for few months. The new standard practices remain unchanged from the ones devised in 2001, with no metrics on the mitigation of debris from unsuccessful missions. There are no action plans framed for the existing debris in the space. As the space economy is growing, it can prove to be a trillion-dollar industry in the future. Yet the American government is unwilling to invest $1 Billion per year towards the mitigation of risks[31].

As USA contributes to 30% of the total space debris, the action towards tackling it has remained remote[32]. It calls for the nation to designate a specialized agency towards responsible space environmental management, along with strategic development for limiting risks. As the United States, holds a substantial hold in the space sector and has dictated trends for its contemporary developed countries and other developing countries, it is important to take a mindful step towards mitigation of space waste. If a space

---

30 *Mitigation of Orbital Debris in the New Space Age*, FEDERAL REGISTER, UNITED STATES GOVERNMENT, (August 25. 2020) https://www.federalregister.gov/documents/2020/08/25/2020-13185/mitigation-of-orbital-debris-in-the-new-space-age

31 Brian Weeden, *The United States is losing its leadership role in the fight against orbital debris*, THE SPACE REVIEW, (February 24, 2020) https://www.thespacereview.com/article/3889/1

32 Kathy Jones, Krista Fuentes and David Wright, *A Minefield in Earth Orbit: How Space Debris is Spinning Out of Control*, SCIENTIFIC AMERICAN, (February 01, 2012) https://www.scientificamerican.com/article/how-space-debris-spinning-out-of-control/

superpower like the USA falters its space policy, it puts up an inept roadmap for other countries to follow. There is a huge scope to fill from their standard space practices, which can help in developing a successful program towards space environmental risk mitigation.

Space Archaeology and Space Waste: Heritage Value of Debris

Space Archaeology is the study of man-made articles found in space to trace human activity in space. Australian archaeologist, Alice Gorman is a notable personality in the field of space archaeology, also known as Dr. Space Junk. In her book, Dr. Space Junk vs The Universe, she has advocated the cultural significance of space waste[33]. She recognizes that even though space junk is problematic, but it is an important part of heritage understanding. Some of this junk is considered to be functional as they still have fuel and can transmit signals, but there has not been much development in segregating the waste in an absolute form[34].

As much of the space archaeology is based on remote-sensing and studying satellite imagery, destroying all of the space debris can harm the study of space history. There is no way of segregating useful and wasteful debris. But, if we are envisioning a future where private players are taking up the space industry, with booming tourism in space it is important to strike a balance between development and degradation.

---

[33] Kathy Page, *Dr Space Junk vs The Universe: Archaeology and the Future*, ROYAL SOCIETY OF CHEMISTRY, (June 12, 2020) https://www.chemistryworld.com/review/dr-space-junk-vs-the-universe-archaeology-and-the-future/4011698.article

[34] Lee Billings, *Space Archaeologist Probes History in Orbit*, SCIENTIFIC AMERICAN, (September 25, 2019) https://www.scientificamerican.com/article/space-archaeologist-probes-history-in-orbit/

Road Ahead: Mapping a Better Future for the Space Environment

As humans who are increasingly becoming reliant on technology and satellites, we can't dispose of it off completely. Science, technology, digitalization, and satellite technology come together in our day to day activities of communication, navigation, etc. Hence, curbing scientific growth by not launching satellites and rockets in space is not a viable solution.

- ***JAXA's electrodynamic tether and unwavering support from the United States*:** Japan's space agency, JAXA is proactively testing an electronic space whip known as electrodynamic tether (EDT). This ambitious project aims to knock debris out of orbit so that it ends up burning in the Earth's atmosphere[35]. JAXA monitors space debris round the clock at their Kamisaibara and Bisei Spaceguard Centres, where radars and optical telescopes are used to monitor debris in the geostationary Earth. The United States, the Joint Operations Centre (JSpOC), and Japanese satellites work together towards the threat of being hit by debris. Usually, the JSpOC issues a warning a week in advance. These warning notifications help in identifying approaching harm[36]. However, there is still a dearth of debris prediction monitors across countries, which can be met by specific R&D towards debris impact prediction.

---

[35] Maya Wei-Haas, *Space junk is a huge problem – and it's only getting bigger,* NATIONAL GEOGRAPHIC , (April 25, 2019) https://www.nationalgeographic.com/science/space/reference/space-junk/

[36] Mayumi Matsuura, *Preventing Collisions Between Debris and Spacecraft,* JAXA, https://global.jaxa.jp/article/2017/special/debris/matsuura.html

- ***Strengthening Legal Framework & Auditing Space Debris*:** Developing a strong background in international law and policy, can help put a uniform system of managing space debris. Strengthening of the Registration Convention is very important, along with making sure every country is keeping a record of the space debris produced by them[37]. The onus of ratification of a new rocket/satellite should lay with the registration convention rather than the countries, hence registration should be done before the launch. Fixing timelines and creating a barrier of 'debris clearance mechanism' can help in navigating the problem of space waste.

- ***Fixing space environmental pollution thresholds:*** Space clean-up projects can only be a success if there is ownership of the waste generated. Due to military and strategic reasons, it is unlawful for one country to meddle with another country's space objects or even waste. Hence, every country should have a definite space clean-up plan before launching a project. If the space debris of a country is beyond the threshold, it should attract penal provisions. Laying a foundation where technological advancement cannot be possible without environmental balance is very crucial.

- ***Improving Research and Development towards 'Green Satellites':*** Inactive satellites form the majority of space junk. With private players joining the space game, the number of objects in space is likely to grow multiple folds. Over 21,000 pieces of space trash are larger than 4 inches along with half a

[37] Sophie Kaineg, *The Growing Problem of Space Debris*, 26 Hastings Envt'l L.J. 277 (2019) https://repository.uchastings.edu/hastings_environmental_law_journal/vol26/iss2/5

million smaller pieces, which is unaccountable[38]. A larger number of inactive satellites are bound to remain in space, while a few orbits back and end up burning in the Low Earth Orbit. The oldest inactive satellite orbiting the Earth is Vanguard 1, launched in 1958[39]. It is not hard to imagine similar inactive satellites still orbiting the Earth. Sometimes, those satellites which orbit back and don't burn up, fall back on Earth. 'The Spacecraft Cemetery' in the Pacific Ocean is the hotspot for space objects which didn't burn up entirely before orbiting back to Earth[40]. Hence, enabling R&D towards creating satellites that don't remain in space for an infinite time is crucial.

- ***Tackling Smaller Space Debris through nets and harpoons:*** Space junk is considered as the fastest traveling junk, between the speed of 40,000 and 56,000 km/h. Even though the larger objects can be tracked the smaller pieces of debris usually misses the eye. European space scientists are working towards developing tethers and nets along with robotic arms. The e.Deorbit mission is set to launch in 2023. It aims to remove the single ESA-owned debris from the low earth orbit utilizing de-orbiting into the atmosphere[41]. While laser technology has gained momentum towards tackling space debris. German Aerospace Center (DLR) has envisioned a laser-based tracking

---

38 Nola Taylor Redd, *Space Junk: Tracking and Removing Orbital Debris,* SPACE.COM (March 08, 2013) https://www.space.com/16518-space-junk.html

39 Eric Betz, *Vanguard 1: Earth's oldest artificial satellite that's still in orbit,* ASTRONOMY.COM, (July 09, 2020) https://astronomy.com/news/2020/07/vanguard-1-earths-oldest-artificial-satellite-thats-still-in-orbit

40 *Where Do Old Satellites Go When They Die?,* NASA Space Place, https://spaceplace.nasa.gov/spacecraft-graveyard/en/

41 *Mission e.Deorbit, Phase B1,* SENER AEROSPACE, https://www.aeroespacial.sener/en/products/mission-edeorbit-phase-b1

methodology for determining the location of orbiting objects. This will not only help clear the space debris but also lessen the avoidance manoeuvres[42]. It is important to create an inter-country cooperation model towards developing a uniform method of tackling debris.

Conclusion: Looking Forward to a Clearer Space

When the international space laws were formulated in the 1960s by the UN Committee on Peaceful Uses of Outer Space, it laid down a strong foundation for limiting space debris. However, gradually many countries started navigating and tracking space debris. The US Space Surveillance Network is the most notable body towards monitoring space waste, to which ISRO has followed suit. Although, these efforts are done to navigate space for the successful launch of their satellites. Ben Greene, an Australian researcher has rightly pointed out that within twenty years space could be unusable due to clogging[43]. The future of space endeavours is greatly dependent on the manner we devise our strategies for safeguarding our orbit. To ensure freedom of scientific thought and research, it important to navigate through the mess we have created. Space can be a trillion-dollar industry, only when we make space for a cleaner orbit.

---

[42] *Laser-based detection and removal of space debris,* INSTITUTE OF TECHNICAL PHYSICS, GERMANY, https://www.dlr.de/tp/en/desktopdefault.aspx/tabid-10062/17177_read-41487/

[43] Ceridwen Dovey, *Dr Space Junk Unearths the Cultural Landscape of the Cosmos,* THE NEWYORKER, (September 01, 2017) https://www.newyorker.com/culture/persons-of-interest/dr-space-junk-unearths-the-cultural-landscape-of-the-cosmos

DIAGNOSING ETHICS AND STANDARDS IN THE ERA OF SPACEFLIGHT: EVALUATING THE NEED FOR ETHICAL AND LEGAL STANDARDS IN SPACE MEDICINE

Gyanda Kakar

"Each time man travels out into space, attention focuses on all people, not just scientists. Space medicine, therefore, bears a great responsibility to history and humanity."

Oleg Gazenko[1]

Introduction

The concept of Space medicine originated through aerospace medicine in the 1940s and is now increasingly evolving to meet the standards as ordinary people and astronauts are expanding their habitats into space.[2] Space medicines provides for the realization and management, and implementation of the necessary countermeasures, of physiological and psychological effects on humans in space. Substantial physiological aspects of space travel include weightlessness, heavy inertial forces during lifting and re-entry, exposure to radiation, absence of division of day and night and closed surroundings[3]. Space medicine includes, for example, weightlessness-related osteoporosis and an elevated risk of fractures as a whole.[4]

---

1 *Space Medicine Quotes* (2021). Available at: https://spacemedicineassociation.org/space-medicine-quotes/#:~:text=%E2%80%9CEach%20time%20man%20travels%20out,the%20Exploration%20of%20Space%2C%201964. (Accessed: 15 February 2021).

2 Matignon, L. (2019) *Space Medicine in the history of the outer space conquest, Space Legal Issues*. Available at: https://www.spacelegalissues.com/space-law-the-birth-of-space-medicine/ (Accessed: 15 February 2021).

3 *Space Medicine, Baylor College of Medicine* (2021). Available at: https://www.bcm.edu/academic-centers/space-medicine (Accessed: 15 February 2021).

4 *NASA - Space Medicine* (2021). Available at: https://www.nasa.gov/audience/foreducators/9-12/features/F_Space_Medicine.html (Accessed: 15 February 2021).

Doctors in space medicine are responsible for space staff and participants in spaceflight. These "flight surgeons" are key to developing mitigation strategies in an intense and dangerous environment, ensuring the protection, health and efficiency of space travellers.[5]This covers all phases from selection, education and spaceflight to recovery after flight and long-term health. The recent recognition of this speciality is a training route in this fascinating area of medicine and an important factor in the commercial spaceflight aspirations of the Indian Government.

While certain dangers (such as acceleration, microgravity, radiation and meteorites) are known, physiological risks and uncertainties continue to be emphasized when considering opening up space to a large population of people with various fitness levels and without any uniform or standardized medical selection requirements.[6] Furthermore, the level of physiological risk includes pre-flight, in-flight and post-flight activities, which in turn causes the introduction of realistic steps and bioethical-legal duties such as full disclosure and informed consent.

Physiological Aspects of Human Spaceflight

Space Medicine is a large clinical area addressing the various problems faced by people interested in spaceflights and other aerospace activities. Space medicines risks rely on flight duration and range from physiological and adaptive changes in the human body to psychological isolation and distance from earth. Many physicians, along with committed space medicine professionals and

---

[5] European Space Agency, Space Medicine (2021). Available at: https://www.esa.int/About_Us/EAC/Space_Medicine (Accessed 15th February).

[6] P.D. Hodkinson, R.A. Anderton, B.N. Posselt, K.J. Fong, An overview of space medicine, British Journal of Anaesthesia, Volume 119, Supplement 1, 2017, Pages 143-153, ISSN 0007-0912, https://doi.org/10.1093/bja/aex336.

the aerospace community in general, have the responsibility to consider the impacts of pre-existing medical conditions and ensure the safety of participants in the expanded space flight industry.

A) Due to Microgravity

Microgravity refers to almost weightless climate related to space-flight. It comes from the free fall movement of the missile, as it orbits the earth or goes down the ballistic path across space. In reaction to microgravity, the human body undergoes dramatic changes, like Space Adaptive Syndrome, ethylene glycol fumes, pulmonary oedema, headache, Nausea, Joint Pain, may lead to osteoporosis in some case and increased risk for fractures. The near lack of gravity also contributes to comparatively shifting the location of the abdominal organ, and the diaphragm moves headwards.[7]

Physical test results and imagery tests such as ultrasound. In addition, this diaphragmatic adjustment results in an enhanced ventilation-perfusion matching with the absence of gravity, which results in a 15 percent decrease in usable residual capacity, and a mild decrease in air ventilation. Sleep on spacecraft is often insufficient due to multifaceted factors such as ambient noise, a tight operating schedule, congestion, back pain and unfamiliar sleep. For example, in the first days in microgravity, there are several case reports of urinary retention. Long duration of stays in microgravity contribute to loss of bone mineralization due to skeleton unloading.[8]

---

[7] Thompson, A. (2019) *Medicine in Space: What Microgravity Can Tell Us about Human Health*, *Scientific American*. Available at: https://www.scientificamerican.com/article/medicine-in-space-what-microgravity-can-tell-us-about-human-healt h/ (Accessed: 15 February 2021).

[8] "Space Medicine in the Era of Civilian Spaceflight, Jan Stepanek, Rebecca S. Blue, Scott Parazynski

B) Radiation

Radiation is a big obstacle to human exploration at Mars, based on existing radiation shielding and spacecraft options. The four types of space ionizing radiation are: cosmic galactic radiation (CGR), photovoltaic (SPE), solar proton and trapped radiation. The atmosphere and geomagnetic field of Earth shield us from ionizing space radiation.[10] Except for Earth's geomagnetic defence, cosmic radiation causes cellular DNA damage, impedes cytokine response, and increases the risk of some cancers.

C) Neurological System

When deployed in the space world, acute changes in the neurological system occur. They lead to the syndrome of Space Adaptation and the disturbance of visuosomotor monitoring and vestibuloocular reflection. With extended mission duration, the impairments of the neurovestibular system seem to be more severe.[11]

D) Re-Landing, Post Flight Considerations

Re-entry medical issues include the risk of: (i) depressurized spacecraft, ii) fire crashes; iv) normal landing trauma.(e.g. loose articles and impacts) and (v) post-landing survival, which may involve a risk of water intrusion while landing off-nominally away from emergency facilities or landing in winter. Astronauts can experience widespread fatigue, orthostatic intolerance, and neurosensory disruptions immediately following the landing, including pitch sensitivity that may impact the walking capabilities of a person. On arrival at Mars surface, similar considerations may be needed.[12]

E) Occupational Health Hazards

Spaceflight contains many substances that are potentially dangerous. In order to minimize iodine, water is treated with trialkylamines as a failure of the water treatment system has caused drinking water to be polluted. Despite substantial consumption, the danger to vehicles can be posed by astronauts has not been negative for their health but has been highlighted.

Exposure to hydrazines, used as rocket fuels, is another example.[13]

F) Decompression Sickness in Space

Decompression is triggered when a person is subjected to reduced environmental pressure by the production of nitrogen gas from tissue or body fluids. Symptoms range from joint pain to the debilitating neurological effects of confusion, engine inconsistency and loss of consciousness more seriously.[9]

What is Space Medicine?

Space medicine can generally be defined as: "Practice in all areas of prevention such as screening, healthcare and human performance in the extreme environment in Space and long-term health preservations of space passengers."[10] Space medicine has its roots in a developing field of healthcare aerospace medicine, though based on individuals' well-being so that they could perform safely and return to earth from extreme environments that are increasingly remote, for example brief space flights, long-duration space station flights, moon trips, and exploration missions beyond the Earth's

---

9 Ball J.R, Evans CH, Eds.: Astronaunt care for exploration mission Wanshigaton D.C. National Academy, Press, 2001 "Safe Passage."

10 Campbell MR, Mohler SR, Harsch VA, Baisden D. Hubertus Strughold: the "Father of Space Medicine." Aviat Space Environ Med 2007; 78:716- 719.

orbit in the next step, including missions involving planetary colonization. Space medicine is primarily designed to promote human flight mission and space exploration.[11]

Another complementary dimension, namely social injustice, is required for space medicine.[12]The social dimension, which involves ethics and social injustice, is thus ignored in space medicine alone, focusing on biology and physiology. Space medicine is one side of a coin where medical astro-sociology the other. The two combined perspectives establish a full view of spatial science, as terrestrial medicine and medical sociology all share on Earth. Healthcare astro-sociology from a social science point of view, astro-sociology turns the attention of those involved in space medicine into a single new field.[13]

- ***Aviation Medicine***

  In contrast to space medicine, the research in aviation medicine focuses on the biology and psychology of aviation. Important medical aspects of air travel include exposure to temperatures changes, high inertia, oxygen deprivation and air sickness, jet lag as well as pilot fatigue. For example, aviation medicine and the harmful consequences of noise and air pollution and associated propagation of disease.[14]

---

11 Ibid.

12 Chapter: 6 Exploring the Ethics of Space Medicine, Safe Passage: Astronaut Care for Exploration Missions (2001). Available at: https://www.nap.edu/read/10218/chapter/8. (Accessed on 14th February 2021).

13 Lily Srivastava, Space Medicine and the Law, Current Developments in Air and Space Law. Available at http://nludelhi.ac.in/download/publication/2015/august/Current%20Developments%20in%20Air%20and%20Sp ace%20Laws.pdf.

14 *What is Aviation Medicine? International Civil Aviation Organization* (2021). Available at: https://www.icao.int/safety/aviation-medicine/pages/desc.aspx (Accessed: 15 February 2021).

- ***Aerospace Medicine***

  The aerospace medical fields concern the fitness, protection and productivity of aviation and space travellers.[15] The amount of aviation and space medical treatment in the flight in and out of the world atmosphere is aerospace medicine. Aerospace medicine is a discipline that connects physics, life support and emergency medicine and aircrew and aerospace patient safety medicine. The atmosphere is fast becoming human hostile. The world is increasingly becoming increasingly aggressive for humans. We have established our understanding of aerospace medicine exponentially from our earliest physiological observations of balloonists in the 1700s to the altitude studies by Paul Bert in 1878[16] to our latest reports by the US Air Force School of Aerospace Medicine in 2008. The US led the Iraq war and the recent hurricanes and earthquakes demanded rapid technical developments and strategies in order to quickly evacuate seriously injured soldiers and a large number patients who cannot be transferred immediately. The Indian Aerospace Medicine Association was founded in 1952, aiming

(a) to advance Aviation and Space Medicine Science and Art,

(b) establish and sustain aero medical growth and advancing cooperation between medical and other sciences, and

(c) foster the security and conservation of air and space enterprises safety.

---

[15] *AsMA Aerospace Medical Association* (2021). Available at: https://www.asma.org/about-asma/careers/aerospace-medicine (Accessed: 15 February 2021).

[16] *Paul Bert French physiologist and politician* (2021). Available at: https://www.britannica.com/biography/Paul-Bert (Accessed: 15 February 2021).

In[17] order to promote the cause, the society supports the field through the organisation of annual conferences, encourage contact between its members and experts from all over the world, publish an Indian Aerospace Medical Biannual Journal and support research activities.

Brief History of Space Medicine

A panel on 'Aero-medical issues of Space Travel' was organized in 1948, nine years before Sputnik I (first artificial earth satellite) was launched by Col. Harry G. Armstrong.[18]Presentations were made by Hubertus Strughold and Heinz Haber, two physicians and commentary from six prominent university and military scientists. Strughold coined the word space medicine for the first time at this panel. He later became a co-founder of Space Medicine Branch of the Medical Aerospace Association in 1950, and was recognized as "The Father of the Space Medicine," through his excellent work.[19]

In 1963, the Space Medicine division launched the Hubertus Strughold Award for the greatest accomplishment in space medicine each year.[20] Recently, the astro-physician Dr Joe Ker win was honoured for his work on the understanding of human physiology during spaceflight and advancement in the practice of space medicine by the Aerospace Medical Association (AsMA), in its Annual Conference in Phoenix in May 2010.[21]

---

[17] *Indian Journal of Aerospace Medicine - About Us* (2021). Available at: https://indjaerospacemed.com/about-us/ (Accessed: 15 February 2021).

[18] *Sputnik 1* (2021). Available at: https://www.nasa.gov/multimedia/imagegallery/image_feature_924.html (Accessed: 15 February 2021).

[19] David R. Williams: A Historical Overview of Space Medicine, MJM 2001 6: 62-65.

[20] *Hubertus Strughold* (2021). Available at: https://nasa.fandom.com/wiki/Hubertus_Strughold (Accessed: 15 February 2021).

[21] Matignon, L. (2019) *Space Medicine in the history of the outer space conquest, Space Legal Issues*. Available at: https://www.spacelegalissues.com/space-law-the-birth-of-space-medicine/ (Accessed: 15 February 2021).

Covid-19 and Space Medicine

Human space travel is carried out in an austere, remote and physiologically difficult environment with medical supplies severely restricted by strength, weight and size considerations and the present crew's mix of skills. Furthermore, this environment is a danger to the health and safety of the entire crew through the incapacitation of someone who has a vital role in a mission.

Adequate prevention by screening is the most effective way to mitigate major physiological risks imposed by spacecraft. Spaceflight medical standards have historically played a major role in recognizing problems that could endanger the project.

Astronauts are subject to a wide range of stressors, from radiation and microgravity to constant changes in fluids, circadian shifts and long-term isolation and containment psychological stress. ionizing radiation can increase oxidative stress and damage to DNA, dysregulate the immune system and affect the effectiveness of the cell protection mechanism in deep space missions beyond the scope of the Earth magnetosphere.

COVID-19 fatality, or for that matter any infectious disease could thus be significantly higher in comparison to Earth due to[22]

a) ineffectiveness of social distancing due to microgravity
b) dysregulation of the immune system;
c) higher rates of RNA virus mutation, like Sars-CoV-2
d) high selective pressure, and
e) maximum oxygen consumption decreased.

[22] J.S. Welsh et. al. Why can COVID-19 fatality in space be significantly higher than on Earth? Volume 18, No 3 International Journal of Radiation Research, July 2020.

Thus, due to decreased microgravity (but high-LET) space and other stressors in space combined effects, the astronauts' or any human spaceflight participant's immune system should thus be closely studied for any infectious diseases as well. Thus, there is potential for developing space medicine in the area of infectious diseases as well.[23]

Space Medicine: Future and Challenges

The human beings face microgravity in the space world. It varies from what we are used to on earth's surface from the flow of body fluids such as blood. This in turn affects the volume and distribution of body fluid, without the influence of gravity. The Institute of Aerospace Medicine IAF Bangalore identified the following working areas in order to support the ISRO Human Space Program (HSP).[24]

a) Selection and preparation of vehicle crew.
b) Framework of Life Support and Climate Control (ECLSS).
c) Crew Module Configuration of Human Engineering Work Station.
d) Psychological isolation and control.
e) Manned Space Program human factors considerations therein.
f) Research in the area of microgravity.
g) Regulation of gravity tension at different Space Travel stages.
h) Medical and Surgical Management Clinical Room.
i) Protection against radiation.
j) Space-based toxicology.

[23] Space Medicine & Life Sciences Project Group Annual Report 2020, (2021) *Spacegeneration.org*. Available at: https://spacegeneration.org/wp-content/uploads/2020/12/SMLS_Annual_Report_2020_Final.pdf (Accessed: 15 February 2021).

[24] VSM Air Cmde Pankaj Tyagi, 'Key Note Address' Romance to Reality: Operational Aeromedical Status of Indian Journey into Space 2007.

k) Device Architecture of Emergency Survival.
l) Life Support System for Space Station.
m) Development of Extra Vehicular Activity.
n) Regulation of heat stress.
o) Space Medicine Operations.
p) Supervision of scientific and technical personnel.
q) Aero Medical Support Development.

The extension of human spaceflight to and beyond low-earth orbits in the last 40 years has been a problem for healthcare and safety clinicians. Space medicine is now entering an evolutionary stage of understanding the human physiological changes as a result of s pace flight into disease and space injury prevention, diagnosis and therapy. The next decade's operational objective will be the development and utilization of the International Space Station's research capabilities to enable secure human space travel beyond the bottom of the earth, and commercial travel to Mars and Moon.[25]

The next step of exploration can include people returning to the moon for long periods in lunar habitats or sending people to Mars to discover signs of life elsewhere in our solar system. If space technology is established in this millennium, humans may well become a space faring civilization following the rapid growth of air travel in the last century. The day will come when certain people spend their entire time in space.

Existing Standards and Regulations

The visibility of space is an overall paradigm of standard astronaut-coastal physiology to microgravity and then minimize changes which can endanger the health of

[25] Joseph P. Dervay, Capston, Analysis of aspects of health care delivery and safety for space tourism and space passengers May 2008.

the astronaut/cosmonaut in orbit and earth adjustments. The article "*Medical Qualification of a Commercial Spaceflight Participant: Not Your Average Astronaut*" recorded the efforts to fly Gregory Alson, the 3rd participant to the International Space Station, after an effective intervention, initially medically disqualified astronaut.[26] The experience from this and other difficult cases in the future would include a validated method for space medicine to resolve medical protocols and medical systems on-board. It may likely be necessary to establish a volunteer national monitoring system for repositories of information on issues such as the forms, diagnostic or care assessed and approved/disapproved medical conditions, used to clear a patient's health or safety event during pre-flight training and any other treatments. This system would contribute by increasing health and safety knowledge of the physiological effects of flight on a number of underlying conditions in space medicine. Foreign companies' involvement in such a scheme undoubtedly would contribute to this knowledge and thereby serve the welfare of foreign passengers and crews.

NASA may well be a data management clearinghouse for such a reporting system if it wishes to extend its awareness of space medicine and promote protection. The programme, which aims at optimizing the health and protection of the flight population, will minimize risk and reduce liability. A resolution urging relevant agencies to establish the relevant U.S. Federal laws, practices, protocols and regulations ensuring safety and health for human crew and passengers in the manned trade region.[32] Medical guidance for

[26] Jennings RT& others. Medical qualification of a commercial spaceflight participant: not your average astronaut. Aviat Space Environ Med 2006; 77: 475-484 [32] Supra at 18.

space travellers and spaceflight have been published by the Aerospace Medical Association(AsMA).

The FAA Aerospace Medicine Office issued a report for the 8th FAA Commercial Space Transportation Predictions Recommended Guidelines for the Medical Screening of Commercial Space Passengers on 11 February 2005. A five partner Space Agencies in the United States, Russia, Europe, Canada and Japan have established the International Space Station (ISS) Medical Programme. As an aspect of the medical programme, medical standards have developed and one set of standards addresses paying passengers, Space Flight Participants (SFP). The SFP requirements allow flights to last for up to 30 days.

The United States is the only country with licensing requirements for Human Spaceflight commercial operations. The U.S. Commercial Space Launch Amendments Act, 2004 defines

a suborbital spacecraft, clarifies the licensing procedures for those spacecraft, allows the FAA to issue permits and enables passengers to fly in space at their own risk. The Act requires that space passengers are fully informed of all possible risks associated with participating in space flights (informed consent). Relatively healthy astronauts have been selected for space flights and from the medical point of view since the beginning of manned space exploration.

However, some of these experienced astronauts who have been tested very closely and eventually for safety tests and monitoring, have had a number of on-ground and in-flight medical incidents training.

At the moment, the Human Exploration Framework Team (HEFT) provides the decision support to NASA for planning any human

spaceflight beyond the LEO (Low Earth Orbit). The consequences for exploration and review of the rate of development of the radiation reduction, the Stable Environmental, Control, Life and Support System and a deep-spaces habitat system are addressed by HEFT. It also addressed the implications of the launch of Orion derivatives and crew.[27]

Medical Liability for In-Flight Events

Doctor's on-board an aircraft (this should apply for future space transportation as well) are expected to follow the same quality of medical care as doctors in a hospital setting. The norm developed in the case of *Bolam v. Friern Hospital Management Committee* is a medical opinion developed as the Bolam test. The measure is the benchmark of an average professional man who has this particular talent and professes it. A man does not need to have the highest ability; a well-established norm is that it is appropriate if he exercises the ordinary skill of a skilled man who exercises this unique art.

According to this test, if a doctor has practiced responsible clinical standards, it is not negligence. He is measured by the level of knowledge and sophistication that a physician in his profession should expect. A doctor who complies with responsible clinical standards will not be negligent just because 'there is a body that holds an opposite view.' The court would rely on independent clinical advice to decide whether a doctor is negligent or not.

---

[27] *NASA - Human Space Exploration Framework Summary* (2021). Available at: https://www.nasa.gov/exploration/new_space_enterprise/home/heft_summary.html (Accessed: 15 February 2021).

Ethical Viewpoints from a Medical Perspective

Preventive and occupational space and terrestrial medicine, cover similar reasons. Medical decision-making involves balancing the safety, well-being, livelihoods for people and the success of missions. These variables, from mission design, production and implementation through selection, training, monitoring and crew support, affect each aspect of space medicine practice.[28] In view of the possible dangers of the space, not all medical contingency in the flight can be fully predicted. However, widespread on-board medical protocols and scenarios will provide a mechanism for crew and staff to reduce deliberation on decisions that influence mission operations such as mission evacuation or abortions.[29][30]

In exceptional cases, physician roles during large-scale civil or military airlift operations are:

a. Medical aero screening: identify an ambulatory, litter, track, intubated and psychiatric classification patient classification. This triage effort often requires a precedence' determination, as well as basic medical specifications such as suction equipment or IV drips (immediately or when space is available).
b. Validation: A medical expert analysis where possible.
c. Medical preparation: 'Packaging' the patient with flight stressors, including splinting, anti-emetic and storage of adequate medicinal products and equipment needed.
d. Clearance: final patient assessment and gaining service acceptance.

---

[28] Medical Safety Considerations for Passengers on Short-Duration Commercial Orbital Space Flights "International Academy of Astronautics"; Study Group.

[29] Supra at 18.

[30] Hurd WW, &others Physician roles in aero medical evacuation: current practices in USAF operations. Aviat Space Environ Med. Jun, 2006; 77(6): 631-8.

The space medicine program at the Johnson Space Centre aims to establish standards and procedures on onboard medical care vessels like the International Space Station, for instance, through the Clinical Care Capability Development Program (CCCDP).[31] It must be studied from the viewpoint of space medicine before any technology is approved or suggested. To evaluate the main limiting factors that may be identified in the space world, procedures or techniques must be checked. Normally volatile anaesthetics or intravenous fluids that require gravity may not be used.

Four goals are to be accomplished by a careful review of medico-legal dimensions of commercial orbital space transportation:[32]

a) Ensure protection of passenger/participant flight;
b) Advancement of the space industry commercial flight;
c) Establish the rule of law in the emerging field of space applications against medical requirements; and
d) Ensure protection in commercial and medical matters for operators of space exploration.

The following legal issues must be considered:(1) legislation applicable; (2) competence, jurisdiction and license; (3) responsibility for exposure to health risks; and (4) informed consent. International space law and separate national space legislation are to be applied.

---

[31] *TSHA | Aerospace Medicine, Lyndon B. Johnson Space Center* (2021). Available at: https://www.tshaonline.org/handbook/entries/aerospace-medicine-lyndon-b-johnson-space-center (Accessed: 15 February 2021).

[32] U.S. Congress, Office of Technology Assessment, "Space Stations and the Law: Selected Legal Issues -- Background Paper" (1986). Documents on Outer Space Law. 12. https://digitalcommons.unl.edu/spacelawdocs/12. (Accessed 15th February 2021).

Legal Remedies under Various Statutes

(A) Liability under Tort Law/Contract Law

Passenger liability can be decided by contract or by tort law if that is provided for by applicable national legislation. In certain jurisdictions, such arguments are regulated by the rule of the lex loci delicti, which is the law of the place of the wrong. Contractual stipulation, the rules of the plaintiff or defendant or the rule of a forum are used as factors in deciding the law applicable.

(B) Waiver of Liability-Volenti Non Fit Injuria[3334]

The sacrosanct nature of contracting parties is to promote the space tourism industry. In this sense, it should also be noted that while space flights remain inherently dangerous, space tourists are aware and are willingly placed at such high risk. Contractual liability waivers will also be recommended, even in the event of the unfortunate death of the space flight participant. Thus, if the well-informed participant waives his right to protection, the spaceflight operator will be discharged of any liability as per this maxim.

(C) Space Insurance

Human space travel brings new risks to the various businesses concerned; Space Insurance is one such sector.[35] The ISS will now host visitors who are not funded by governments but by the private commercial sector. These individuals could be NASA

---

33 Jaffey, A. J. E. "Volenti Non Fit Injuria." *The Cambridge Law Journal*, vol. 44, no. 1, 1985, pp.

34 110. *JSTOR*, www.jstor.org/stable/4506702. Accessed 15 Feb. 2021.

35 Matignon, L. (2019) *Space Insurance & Space Law - Space Legal Issues*, *Space Legal Issues*. Available at: https://www.spacelegalissues.com/space-insurance-space-law/#:~:text=Today%2C%20%E2%80%9CSpace%20Insurance%E2%80%9D%2C,the%20risk%20of%20liability%20claims. (Accessed: 15 February 2021).

astronauts as with the SpaceX crew, but they could also be workers of the launch company or space tourists. NASA and the FAA are also refining how these new threats are handled.[36] The space underwriters are collaborating with the private space companies and NASA/FAA to build the insurance product that adequately addresses the risks faced by the private sector when it comes to human flight, unlike the already available third-party liability insurance offered by various companies like Global Aerospace. When the space industry grows so do the insurance schemes that address the hazards. The insurance in the form of passenger and passenger liability policy is another mechanism to mitigate risk of medical-legal liability and promote space transportation . The operator is covered from its legal obligations towards passengers by the Passenger Liability insurance.[42] On behalf of the insured party, insurers agree to pay any amounts which the insured are legally liable to pay as damages.[43]

(D) Informed Consent

Each participant in space flights must have their written informed consent and written approval of the compliance with the physical examination to participate in the space flight. At the moment, we have the Rotterdam Convention,[44] on the International Trade of Pesticides and Hazardous Substances, which provides for prior informed consent. Also, the Oviedo Convention[45] provides for the informed consent in matters of bio-medical research, we need to take inspiration and thus develop proper provisions for informed consent in the interest of furthering space transport sector.

---

[36] *Space Insurance and the New Era of Space Exploration | Global Aerospace Aviation Insurance* (2020). Available at: https://www.global-aero.com/space-insurance-and-the-new-era-of-space-exploration/ (Accessed: 15 February 2021).

In view of the limits on the number of people we can send to space and the inability to draw on conventional clinical research, ISRO should explore acceptable approaches in a terrestrial context and additional ways to minimize the risk validly. In order to understand and model structural changes in bone, Quantitative computed tomography (QCT) was investigated, for instance, which individual astronauts on a space flight underwent independent of Omics knowledge.[46] However, this may not be the best option since this discriminates between populations on the basis of genetics.

Participants who are probably older and more inclined to report Co-morbidity. These requirements are considerably lower than for highly qualified astronauts and/or crew members on long-term ISS mission. In 2005, a male, 60 years of age flew onboard the ISS with a background of health issues. These health issues, normally, would have precluded the appointment of any competent astronaut. However, this male was allowed to fly. Thus, in order to understand the potential resistance to the rigors of suborbital flight of this new population of space voyageurs, preliminary research on possible participants need be performed.

Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine, Oviedo Convention, 1997.

Internationals Treaties and Jurisdiction

The following conventions and treaties were adopted post the establishment of Committee for Peaceful Uses of Outer Space (UNCOPUOS) in 1959.[37]

[37] *COPUOS* (2021). Available at: https://www.unoosa.org/oosa/en/ourwork/copuos/index.html#:~:text=The%20Committee%20on%20the%20Peaceful,for%20peace%2

A) Rescue Treaty of 1968

The rescue treaty provides for the provisions on astronaut rescue as well as return of objects launched in the space.[38]

B) Convention on Registration, 1974

The launching state must register space object under international space law, in compliance with Article II of the Convention on Registration.[39]

C) Space Liability Treaty, 1971

It will be completely incumbent upon the launching country to compensate for death, injury or property damage resulting from the objects which that country launches. The "launching state' is responsible for the loss incurred on board the target of a space where the loss is caused by negligence or the fault of the persons for whom the damage has been caused by Article III of the 1972 Liability Convention.[40]

D) Outer Space Treaty, 1967

This Treaty stipulates that the outside space should be used for peaceful purposes only and is not subject to national appropriation. Article VI of the Outer Space Treaty of 1967 makes States parties 'internationally responsible' even though non-governmental

C%20security%20and%20development.&text=The%20Committee%20was%20instrumental%20in,five%20principles%20of%20outer%20space. (Accessed: 15 February 2021).

[38] *Rescue Agreement* (2021). Available at: https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introrescueagreement.html (Accessed: 15 February 2021).

[39] *Registration Convention* (2021). Available at: https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introregistration-convention.html (Accessed:15 February 2021).

[40] *Liability Convention* (2021).Available at: https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html (Accessed:15 February 2021).

organisations are carrying out those activities. Such practices require the competent State to 'authorize and monitor continuously.' The licensing process usually fulfils this duty.[41]

E) Moon Treaty, 1979

It includes the industrial use of the Moon.[42]

Governments have adopted non-binding conventions in addition to the aforementioned treaties. These resolutions refer to international satellite transmission, remote sensing and the use of nuclear power in space. It is however critical that these treaties do not require Member States to implement requirements for crew, vehicle or passenger safety and certification. An absence of safety rules may lead to international liability under the Convention on Liability. To date, no customary international law regulations on passenger protection or medical-legal liability for commercial orbital space travel have been established because of a lack of consistent experience and the assumption that such procedures are mandatory. It tends to be sufficient to provide minimum regulations and compliance with minimum passenger safety requirements. Other Conventions list the roles of other transport networks which can be used as a framework in cases of death or injury to passengers.

In compliance with Article 17 of the Warsaw Convention of 1929,[43] an airline is held responsible for the harm incurred in the event of death, illness or other bodily damage to a passenger. If the accident

---

[41] *Outer Space Treaty* (2021). Available at: https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html (Accessed: 15 February 2021).

[42] *Moon Agreement* (2021). Available at: https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/intromoon-agreement.html (Accessed: 15 February 2021).

[43] Convention for the Unification of certain rules relating to international carriage by air, commonly known as the Warsaw Convention, 1933.

which caused so much damage occurred on board or during one of the embarking or disembarking operations. If an air carrier is alleged, which jurisdiction may be exercised by the injured person or the other family member? Pursuant to Article 28 of the 1929 Warsaw Convention, passengers can select one of four competent authorities to sue-

- The carrier's place of incorporation
- the location where the carrier has its headquarters
- The destination spot
- the location through which the carrier has a facility
- the location in which the contract was concluded.

Conclusion

Various comprehensive medical, legal and ethical concerns about the safety and health of civil spaceflight participants (SFPs) are posed by commercial human spaceflight.[44] A variety of commercial sub-orbital, orbital, interplanetary and point-to-point space transport are being proposed by new and developing private companies like SpaceX and Blue Origin. However, it is unlikely to create a solo risk assessment or approach to spaceflight as a unifying action because of the diversity of mission design, procedures, flying objectives and duration. Apart from the ones listed in this paper, there are still many scientific, technical and medical uncertainties in space flights, even after almost 50 years of '*evolution*' of human spaceflight.

To summarize the discussion above, to make commercial human spaceflight possible and when we examine the issue of space medicine from a legal aspect, we have four main workable solutions,

---

[44] *The Future of Human Spaceflight: Objectives and Policy Implications in a Global Context | American Academy of Arts and Sciences* (2021). Available at: https://www.amacad.org/publication/ future-human-spaceflight-objectives-and-policy-implications-global-contex t/section/6 (Accessed: 15 February 2021).

First, we must discuss current law, in particular space law, and what future law should be. Second, within the scientific community, it is widely accepted that it is very important to provide adequate health care facilities and administer quality health care to astronauts. However, the issues of liability, accountability and harm (kindly refer to ethics section of this paper) in connection with medical practice may be more relevant for the more difficult and distant tasks for the future and must be discussed and extended both nationally, in India and worldwide. Third, develop space medicine as a separate course in traditional medical degrees.

Fourth, to promote space travel, we first need to promote international, cross-centred and interdisciplinary approach of the know-how in the field of aerospace medicine and the development of state-of-art space medicine to facilitate future space exploration in the interest of promoting space medicine and its applications for benefiting humans, on the earth and space. This can be done by framing provisions on informed consent, as discussed above.

We need to use a worldwide laboratory to invest in tomorrow in the quest for more research that will help to sustain Earth's beautiful Earth ecosystem so that the next generation can '*space travel'* comfortably.

VERTICAL TAKE-OFF FOR EVTOLS: POLICY FRAMEWORK AND CONSIDERATIONS

Pushpesh Paliwal & Manan Malviya

Introduction

UAM or Urban Air Mobility has gained traction for solving issues of traffic management and have made a bid towards integration in development of smart cities. Urban Air Mobility has spurred a boost to development of VTOL's. Vertical Take Off and Landing aircrafts are callable of taking off and landing vertically, without the need for a runway. This makes them ideal for urban air transport as they use a relatively compact infrastructure for operation. These are also useful in hilly or mountainuous areas where access is impeded by treacherous roads or the isolated nature of the location itself. The conventional VTOL's contribute to the issue of environmental degradation caused by burning of fossil fuels. They are causal factors for noise and air pollution which is an important consideration for both urban and mountaneous regions. The cost of operations also remains high as the price of fossil fuels surges. In certain areas, additional taxes such as green tax, carbon tax, etc. make the operations expensive. It is to resolve these issues that electric VTOL's are being developed. The electric VTOL's use batteries and electric motors to operate. One of the advantage of these motors is that they provide instantaneous thrust which is easily adjustable, negotiating any environmental changes in wind direction, speed, etc. during take-off and landing. The electric motors reduce the amount of noise generated during take-off and landing. These aircrafts are virtually noise less during operations. The cost of operating also comes down owing to the use of

electricity and the reduced costs of maintaining an electric motor. The positives of the eVTOL's as a whole make them an attractive alternative for public transport or tourism activities. So, why are we not seeing eVTOL's in operations? A variety of factors have hindered the development and adoption of such technologies. The primary issue is with the batteries. The battery technolody at present is not capable of delivering the desired rande and outputs. The batteries also need to be charged between flights. This increases the turnaround time significantlil.An alternative of swappable batteries requires addidional infrastructurs for charging and storing batteries. The eVTOL's are a radical shift in technology ftom conventional aircrafts. So, a certification standard is required to be devised. The certification would require both time and money. In addidion, a number of different companies are developing different aircraft technology which are at varying stages of development. Thus, a common standard is difficult to achieve. A policy which accumulates and weighs in these factors needs to be devised to sustain and achieve any progress in eVTOL's commercial operations.

Financing the eVTOL

Electric Vertical take-off and landing is a developing field in the aviation sector. It is touted to be the next big thing in electric mobility after automobiles. Similar to the automobiles, a lot of investment is required in developing and making the technology industry ready. The investment required is both long term and intensive. A survey of the existing companies and the investment corpus of the companies provides us a snapshot of the same. Joby Aviation, has completed the third round of fundraising with 590 million dollars of funds pouring in. The most has been from Toyota,

with the total investments amounting to 720 million dollars. Lilium is another such company with 340 million dollars behind it.[1] One of the behemoths of this industry was Uber. Uber Elevate was one of the largest and most talked about aviation company. It even released a white pater back in 2016, detailing its plans for urban air taxis. A helicopter service was also started in 2019 to collect data as well to provide an experience of the same to end users. The company has now announced that Joby electric would be acquiring it.[2] The perilous business of electric aviation has other aspects too. It is not only the development and testing but also certification. The investments have come from private investors or from established aviation companies. Kitty Hawk, a company backed by Google co-founder, Larry Page, recently spun-off its aviation business into Wisk Aero. Wisk Aero is now co-owned by Boeing. Thus, eVTOL's at present are heavily backed by private investors with interest in electric aviation.

Another dimension of financing the eVTOL aircrafts is a lack of institutional investors. The institutional investors are wary of investing in new aircraft designs. A possible explanation lies in the disastrous end to the investment boom in very light Jets in the 2000's. Eclipse Aviation is one such example. It had poured in 1.4 billion dollars in developing, certifying and commercially producing the Eclipse 500. The result was that Eclipse Aviation went bankrupt in 2008, taking down one of its key customers Dayjet with it. Similarly, Honda's HA-420, started development in the 1990's did

---

1 New Atlas. 2021. *State of the game: The key players in the emerging eVTOL air taxi market*. [online] Available at: <https://newatlas.com/aircraft/evtol-air-taxi-flying-car-market-players/> [Accessed 15 February 2021].

2 The Verge. 2021. *Uber reportedly will sell its flying taxi business to secretive startup Joby Aviation*. [online] Available at: <https://www.theverge.com/2020/12/2/22086597/uber-sells-flying-taxi-elevate-joby-aviation> [Accessed 15 February 2021].

a test flight in 2003 but could only enter into production in 2015 with the project costs going over 1 billion dollars. The amount of investment and the time taken to commercially produce an aircraft makes investment from institutional investors unlikely. It also adds to the fact that there is a possibility that some better alternatives may exist.[3]

Finally, the governments are another major source of funding to the development projects. The government funding of the eVTOL's has been limited. The EU has set up a Horizon 2020 Collaborative Aviation programme which is used to fund such projects. The government funding also comes with a focus on efficient investment of the public resources. This would mean some influence on regulations and policy making. A possibility of some feasible alternatives with better efficiency and significantly less downtimes implies that a decision would be based on. In this regard, the governments would be better off heeding the advice of Hayek. Hayek was of the view that centralised planning would be inadequate considering the variety of factors involved. The underlying argument is that the knowledge which is required to make such decisions cannot be aggregated as the changes are taking place every day. Thus, the inability to aggregate the dynamic and ever-changing data implies that it is not possible to do centralised decision making. The everyday changes and developments which occur in the aviation industry and the allied sectors are dynamic and ever-changing. In this context, as Hayek discusses, a central

[3] Donovan, D., 2021. *Where Will The Electric Aviation Start-Ups Find $40B?*. [online] Forbes. Available at: <https://www.forbes.com/sites/deandonovan/2019/09/17/where-will-the-electric-aviation-start-ups-find40b/?sh=7283a7c96ee7> [Accessed 15 February 2021].

planning would not yield the best result.[4] It is better to be left to the market forces to decide which technology survives to develop. The price as an indicator for the aggregate of effective knowledge of the actors in the market. This would drive investment into the most promising of technologies. Once a particular technology is successful, incentives by way of certification support and other concessions. A suggested policy framework is along the lines of Heathrow Airport which has declared a waiver of one year on airport fees to any company which develops a commercial electric aircraft.[5] The governments can also provide waiver of some certification fees based on the performance of the aircraft or the stage of certification.

Certification

A production ready commercial eVTOL will still need to be certified. The certification prices for eVTOL's is particularly cumbersome as it requires creation of a new category of aircrafts. A review of the efforts of the FAA and EASA provide us an insight into the challenges faced. The FAA has amended its certification requirements of air worthiness under Part 23. The standards have been changed from prescriptive requirements to a performance based standard. The FAA is working on four active type applications under the new regulations. The Part 23 guidelines provide for certification of small airplanes with passenger capacity of up to 19 passengers. These are not directly applicable to eVTOL's but may provide a pathway for such certification. Greg Bowles of Joby aviation who heads the government affairs division commented that

---

4 Hayek, F.A., 1945. The use of knowledge in society. *The American economic review*, *35*(4), pp.519-530.

5 Royal Aeronautical Society. 2021. *Wiring up the electric aviation revolution - Royal Aeronautical Society*. [online] Available at: <https://www.aerosociety.com/news/wiring-up-the-electric-aviation-revolution/> [Accessed 15 February 2021].

the FAA is working independently with every manufacturer in the means of compliance for the aircrafts. FAA has also indicated that regulator guidelines would be issued once a significant number of the eVTOL's have been developed. The Part 23 categorisation would fail to accommodate the eVTOL's as they get heavier.[6]

The change in regulations has not been a smooth transition. The GAO (Government Accountability Office) presented a report on the implementation of the FAA regulations on 16 Nov 2020. It states that FAA staff performing design reviews reported that they were uncertain as to the level of detail required to be demonstrated by the applicants to meet the new standards. The approach of FAA has been to condense the various regulations into one broadly worded one. An example of this is that FAA has condensed around 32 regulations which listed out in detail the placement and design of various equipment and instruments into a single regulation. The new regulation broadly states that all the equipment should be prominently displayed and their functions clearly indicated. It allows easier certification pathway for aircrafts. The Part 23 regulations have been helpful in certification of eVTOL's. The GAO audit reports of an interview conducted of a fly-by-wire eVTOL. The company representative recounted how it was able to develop and certify its aircraft quicker in the US owing to the amendment.[7]

The regulations also allow the applicants to use the industry consensus standards as a means of compliance. "Means of

---

6 evtol.com. 2021. *Industry and regulators look to each other for progress, harmonization on eVTOL certification requirements - evtol.com*. [online] Available at: <https://evtol.com/features/industry-regulatorslook-each-other-progress-evtol-certification-requirements/> [Accessed 15 February 2021].

7 evtol.com. 2021. *Audit finds room for improvement in FAA's implementation of Part 23 regs - evtol.com*. [online] Available at: <https://evtol.com/news/gao-audit-faa-part-23-implementation/> [Accessed 15 February 2021].

compliance" is a method to show compliance with any regulatory requirements. It is a detailed design standard which accomplishes the safety intent of the regulations if these standards are met. It is used to show that the airworthiness standards under part 23 are met. Now, even though the FAA regulations allow standard such as the ASTM to be adopted as means of compliance, it has been slow to accept them. The applicants have to demonstrate how the ASTM standards map to Amendment 64. One of the applicants reported that it took two years for them to prove the same.[8]

In the meanwhile, EASA has also approved a set of certification standards for VTOL's. The EASA has released three certification standards which allow for certification of VTOL's. The special condition issue of EASA provides for categorisation of small VTOL's. They are described as aircrafts with a capacity of 5 passengers or less or with a maximum take-off weight of less than 2000 kg. These aircrafts are bifurcated into two categories – basic and enhanced. The commercial operations are governed under the enhanced category. The aircrafts must be capable of flight and landing safely despite critical failure of thrust/ lift system. A number of additional certification conditions are also proposed for special operations like over water, etc. In pursuance of these, a clarification on the means of compliance was also issued by the EASA. Thus, creating a more predictable route to certification.

A page can be taken out from the New Zealand's aircraft regulations. The Part 115 Adventure Aviation Certification allows an easier certification pathway for test flights. Wisk Aero has used the

---

[8] 2021. [online] Available at: <https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_23_20101.pdf > [Accessed 15 February 2021].

regulations to get their test flights.[9] An approach to certification through performancebased standards combined with a temporary certification granted for test flights. This would allow the aviation start-ups to collect flight data which is a crucial step towards certification. The data collection will also allow the certifying authorities to analyze data in order to ascertain the standards for safe operations.

Environment

Manufacturing the EVTOL will accompany associated processes and activities like battery manufacturing and disposal, ground infrastructures etc. which has the potential of leaving carbon footprint. Since EVTOLs are not 100% emission free there are permutation and combinations of ways in which EVTOL can be used. Thus the policy and regulation on EVTOL must consider certain factors, so that resulting standardisation of process and usage leads to least emission;

1. Disposal of EVTOL batteries- As of now EVTOL prototypes are primarily based on lithium-ion batteries,[10] which are not devoid of adverse environmental footprint, occuring primarily at production and processing stage[10]. The impacts includes ecological toxicity, global warming, human-health impacts and depletion of resources.[11] India is already a consumer of Lithium-ion batteries for Electric vehicles market, which is approximated to rise by 36% per

---

9 Aviation.govt.nz. 2021. *Part 115 Adventure Aviation Certification and Operations | aviation.govt.nz*. [online] Available at: <https://www.aviation.govt.nz/rules/rule-part/show/115/1> [Accessed 15 February 2021].

10 Shanika Amarakoon, Jay Smith, Brian Segal *Lithium-ion Batteries and Nanotechnology for Electric Vehicles:A Life Cycle Assessment*, NATIONAL SERVICE CENTER FOR ENVIRONMENTAL PUBLICATION, EVIRONMENTAL PROTECTION AGENCY U.S.

11 ibid

year till 2026[12], and with advent of eVTOL the consumption of Li-ion is expected to rise. Between 2020 and 2025, the Indian market of Li-ion battery is projected at Compound Annual Growth Rate (CAGR) of 34.8%.[13] This necessitates a mechanism for recycling and safe disposal. But currently India neither have any authorised facility for recycling of Li-ion batteries[14] nor have dedicated extensive regulation on Li-ion-battery disposal.[15] Suggestion- Battery Waste Management Rules, to be expanded to include regulation for recycling with an aim of preserving/recovering the virgin resources like (nickel, lithium etc.) used to made batteries. Secondly to lengthen the life of battery, which results to less frequent disposal.

2. Airport Infrastructure and ecology- Construction of Traditional Airports requires land, mainly in suburbs and outskirts, which follows mass deforestation[16] and displacement of human[17] and wildlife habitat. The main-structure of airports is also accompanied by associated infrastructure, like connecting roads,

---

[12] Uma Gupta, *EVs: India Lacks Authorized Lithium-ion Battery Recycling Facilities*, PV MAGAZINE, February 11, 2020 https://www.pv-magazine-india.com/2020/02/11/evs-india-lacks-authorized-lithium-ionbattery-recycling-facilities/

[13] https://www.reportlinker.com/p05865917/India-Lithium-Ion-Battery-Market-Growth-Trends-andForecast.html?utm_source=GNW

[14] Supra Uma Gupta, *EVs: India Lacks Authorized Lithium-ion Battery Recycling Facilities*, PV MAGAZINE, February 11, 2020 https://www.pv-magazine-india.com/2020/02/11/evs-india-lacks-authorized-lithium-ionbattery-recycling-facilities/

[15] Ritwik Saha, Swagata Dey, Electric vehicle battery recycling in India: An opportunity for change, DOWN TO EARTH, August 3, 2020 https://www.downtoearth.org.in/blog/pollution/electric-vehicle-battery-recycling-inindia-an-opportunity-for-change-72621

[16] Rose Bridger, Forests and lakes destroyed for Istanbul's 3rd airport, GLOBAL ANTI-AEROTROPOLIS MOVEMENT (GAAM), April 1 2015 https://antiaero.org/ 2015/04/01/forests-and-lakes-destroyed-for-istanbuls3rd-airport-2/

[17] Archana K. Roy, Rahul Rajak, Development Induced Displacement and Rehabilitation: The Study of Navi Mumbai International Airport Project, India, https://uaps2015.princeton.edu/papers/151200

bridges etc. Conversely, Vertiplaces like Vertiports, Vertihubs and vertistations dedicated for eVTOL can operate on substantially smaller areas. An under-planned eVTOL airport in England is speculated to be smallest airport in the world.[19]

Policy on eVTOL airports should either include integration with conventional airport or building them up in areas with. The policy of increasing Urban Air Mobility is better suited with eVTOL the landing and take of which can be operated within the city unlike conventional airports in outskirts.

3. EVTOL emissions and energy consumption- eVTOLs are not 100% eco-friendly, the level of emissions and energy consumption level varies with Flight weight, Distance and Flight-phase proportion. Among the five stages of flight viz, Taking off, climbing, cruising, descent and landing; climb and take-off results in most energy consumption, whereas cruise phase is most efficient. Thus the dominant proportion of flight duration should be cruising to be able to setoff emission caused in pre-cruise phase. Translating it into distance, EVTOL leads to more GHG emission and energy consumption when flight distance is lesser than 35km.[18] Whereas a distance of 100km having full occupancy of 3 passengers and one pilot, results in 6% and 52% lesser emission than BEV (Battery Electric Vehicles) and Gasoline vehicles respectively.

4. Wildlife strikes- Indian Civil Aircrafts have been witnessing a constant increase in wildlife-aircraft collision incidents, the major portion of which comprises of birdstrike.[19] The

---

[18] Kasliwal, A., Furbush, N.J., Gawron, J.H. *et al.* Role of flying cars in sustainable mobility. *Nat Commun* 10, 1555 (2019). https://doi.org/10.1038/s41467-019-09426-0

[19] Srinidhi et al. *Wildlife Collisions to Aircraft in India - A Comparative Analysis of Hazardous Species Involved in Different Time Periods*, Defence Life Science Law Journal Vol.5, No.3

wildlife strike-rate has a direct co-relation with the expansion of air-traffic. Thus with more eVTOLs bird-strikes likely to rise. Secondly, approx. 90% of birdstrikes occurs below 2500ft AGL(Above Ground Level) with 70% cases below 500ft AGL.[20] The altitude at which eVTOL is expected to cruise is 1000-2000 ft AGL[21], thus falling within critical category.

Suggestion- Consideration Environment and Location- eVTOL Airport and vertihubs to be located in urban mobile locations, with lesser resemblance of vegetative-habitat.

Dynamic Issues

Safety and maintenance

The maintenance, repair and operation (MRO) has developed homogenous practices across the industry, owing to the prevalence of fossil fuel-based turbine engines. The eVTOL's and hybrid engines seek to change that. One of the focus areas for eVTOL's is the battery safety and the maintenance. The eVTOL's are currently powered by high specific energy lithium-ion batteries. The batteries are prone to two major safety issues – uncertainty of stored energy and thermal runaway. In thermal runaway, the temperature of the battery increases uncontrollably due to an internal short circuit. This can cause fires or the battery may explode. The effect can rapidly spread to the neighbouring cells if they are not physically isolated. The factors causing this are over-heating, manufacturing defects, over-charging or manufacturing defects. The prevention of the factors causing thermal runaway has been in the form of operations

[20] Joost Ellerbroek, Isabel C. Metz, et al. *The Bird Strike Challenge,* AEROSPACE, MDPI OPEN ACCESS JOURNALS, March 13, 2020

[21] Andrew J. Hawkins, Hyundai will make flying cars for Uber's air taxi service, THE VERGE, Jan 6, 2020 https://www.theverge.com/2020/1/6/21048373/hyundai-flying-car-uber-air-taxi-ces-2020

and good design practice, but the manufacturing defects have been hard to predict and prevent. The Boeing 787 lithium batteries had manufacturing defects leading to thermal runaway. A solid containment system was devised which contained these events but added a considerable weight. The lithium batteries with less risk of thermal runaway do not have the required specific energy. Another issue is the uncertainty in the battery energy. A catena of factors such as ambient temperature, age, charge/discharge cycles, handling and age affect the energy which can be extracted from the battery. Thus, it is not possible to reliably and accurately predict the stored energy level of a battery without having the relevant information. The batteries would need to be constantly monitored and the data logged to ensure commercially safe flight operations. The safety and maintenance regulations have to develop protocols to ensure that the risk factors for batteries are accommodated.[22]

The maintenance of aircrafts also requires maintaining the motor. The electric motors are less maintenance than internal combustion engines. They would also require frequent inspection of high-speed ball bearings to ensure safety. The motor is prone to damage from contaminants, vibrations or voltage surges. The insulation can be damaged by high temperature causing performance loss. The motor also needs to be completely disassembled for any repairs. This causes a significant overhead. MagniX is developing a motor which can be individually repaired. Thus, the protocols need to consider such technological Developments.[23]

---

[22] Courtin, C. and Hansman, R.J., 2018. Safety considerations in emerging electric aircraft architectures. In *2018 Aviation Technology, Integration, and Operations Conference* (p. 4149).

[23] Imeche.org. 2021. *Electric aircraft pose new challenges for maintenance and repair*. [online] Available at: <https://www.imeche.org/news/news-article/electric-aircraft-pose-new-challenges-for-maintenance-and-repair> [Accessed 15 February 2021].

Air traffic- EVTOL Air-Traffic Management has two aspects;

a) Communication and Navigation- which includes infrastructure for ATM Air-services, tech advancement for Navigational precision and latency, Flight Rules for IMC (In Meterological Conditions) etc. and;

b) Air-Traffic Management (ATM)- which includes prescription of altitude, flight-paths, formulation of dedicated routes and corridors for eVTOLs, re-routing of fossil powered higheraltitude aircrafts and related safety Rules.

Consideration for Altitude (AGL) – 1st Limitation- In comparison to helicopters and fixed wings fossil-fuel aircrafts, eVTOL operate in lower altitude, which is flight altitude for drones as well. The maximum allowable altitude for drones is 400 feet[24]. Thus lower limit on cruising altitude for eVTOL must be above 400 feet. 2nd Limitation- eVTOL must be equipped control redundancy in case of system failure. Ballistic parachutes is one mechanism thereof. But inflation of Ballistic Parachute requires minimum altitude before opening, e.g., Cirrus requires 920 feet for full inflation and thus decelerated descent. Thus cruising altitude for eVTOL should be maintained at the height from where system failure mechanism like Ballistic Parachutes can be made operable.

Flight Rules- For smooth traffic and mitigation of collision broadly 2 categories of Flight Rules operates, VFR (Visual Flight Rules), and IFR (Instrument Flight Rules) depending on the altitude, cloud

[24] SECTION 3 AIR TRANSPORT SERIES X PART I CIVIL AVIATION REQUIREMENTS

clearance and visibility[25]. The altitude ceiling for IFR is 500 -1000 feet AGL and for VFR is above 3000 feet AGL. Between these two ranges (Above 1000 feet AGL to 3000 feet AGL) MVFR (Marginal Visual Flight Rules) operates which is crucial transitional category between two rules[26]. Since, eVTOLS operates in this crucial range of altitude, thus it necessitates regulations under both VFR and IFR. Although in contrast to VFR which is dependent on Visual reference, IFR relies on navigational, communicational instrument on cockpit and most importantly Separation Services from Air Traffic Control on ground. Thus regulation on ATM of eVTOL cannot operate without integration with existing Air-Traffic Rules.

Pursuant above consideration EVTOL policy on ATM requires -

a. exploring the scope of integration of eVTOL-ATC with existing ATM for conventional aircrafts.
b. Distance-wise demarcation of higher and lower altitude aircrafts for reduction of air-traffic
c. Minimisation of Intra-State fossil powered flights, amendment in existing VTOL policy on Helicopters and Drones, and Fossil fuel aircraft

Resource Gaps

Chip Shortage

One of the suggestions to tackle the issue of pilot shortage is autonomous aircrafts. The autonomous aircrafts would incorporate a fail-safe with backup controllers operating with a manual override.

---

[25] Brock Lascara Andrew Lacher, Urban Air Mobility Airspace Integration Concepts, MITRE Corporation, https://www.mitre.org/sites/default/files/publications/pr-19-00667-9-urban-air-mobility-airspace-integration.pdf

[26] Sarah Fritts, The Differences Between VFR, MVFR, IFR and LIFR, THINK AVIATION, June 4 2018

The incorporation of such technology requires not only software such as integrated chips. These semiconductor chips are in demand nowadays. A confluence of several technologies such as Internet of Things, self-driving automobiles, etc. has led to an explosion in demand, barely met by production at present. The pandemic has accelerated demands for semiconductor chips as the consumers hoarded electronics. As consequence, General Motors Co. has to shut down three of its North American plants while reducing production to half the capacity in the South Korean factory.[27] The chip shortages are likely to wipe out 61 billion dollars for sales in automobiles. The shortage has started to affect other industries too. Sony Corporation has announced that it will be unable to meet the demands if its gaming console in 2021. There are also concerns of stockpiling of chips by companies such as Huawei to avoid any repercussions from sanctions. The consumer demand for electronic goods fuelled by the pandemic is another relevant factor. Thus, a deficiency in supply and demand exists which can prove to be a bottle neck in development of vTOL's.[28]

Shortage of Pilots- The demand for *new* pilots in aviation industry globally is expected to be around 763,000 between 2020 and 2039, with Asia-Pacific region being the highest projected recruiter of 248,000 new pilots.[31] In pre-COVID period itself, India's pilot supply did not meet the break-even point, with an annual shortage of approx. 500 pilots against the annual demand of 800.[32] Also The Ministry of Civil Aviation, India, approximated a requirement of

---

[27] Bloomberg.com. 2021. *Bloomberg - Are you a robot?*. [online] Available at: <https://www.bloomberg.com/news/articles/2021-02-03/gm-to-temporarily-shut-trio-of-plants-as-chip-shortagepinches> [Accessed 15 February 2021].

[28] BloombergQuint. 2021. *Chip Shortage Spirals Beyond Cars to Phones and Consoles*. [online] Available at: <https://www.bloombergquint.com/global-economics/chip-shortage-spirals-beyond-cars-to-phones-and-gameconsoles> [Accessed 15 February 2021].

9488 pilots by 2025, which boils down to 1897 pilots per year[33]. Thus aviation industry with conventional technology itself is facing pilot supply deficit. Exorbitant Cost of Instruction cost[34] , lack of training institute[35] and sub-utilisation of pilots largely attributes to shortage of Pilots in India. Although three factors, can be tackled through diversion of existing human and resource capital. Two main factors of exorbitant institute cost are high fuel cost of aviation and high cost of maintenance. Thus a solution could be eVTOL aircraft. As opposed to piston engineaircrafts, configurations of EVTOL can decrease the operating cost per mile by 26%.[36] Secondly, around 32 state-run airports in India are absolutely lying idle, in addition to dozen airports with negligible daily passengers count. Those can be converted into training centres, which is an idea already under contemplation of Indian Government.[37] Thirdly, the subutilisation of pilot potential can be reduced through easing the pilot licencing. The existing procedure for Commercial pilot licensing is cumbersome, costly and lengthy, which includes training, clearance of 200 hours of flying threshold and examination. Multi-Crew Pilot License System is competency based training, adopted by International Civil Aviation Organisation in 2006, which can made the licencing more frequent.

Conclusion

The utopian world of UAM envisaged by companies such as Uber Elevate seems quite a distance away. The integration of aircrafts into the public transport system especially in urban areas, relies heavily on eVTOL's. The eVTOL's are ideal for urban mobility as they create less noise, emit virtually no noxious gases and can easily integrate autonomous flight systems. The urban environment with its tall buidingr and existing helipad infrastructuse is alsi ready for

integration. A possible use-case scenario for the evtols is also in tourism. The tourist spots in several mountaneous regions rely on helicopters to transport people.the use of evtols would reduce the environmental impavt of such activities. While a number of uses and benefits of evtols can be envisaged, fhere are a lot of hurdles to cross for evtols. The very first hurdle is that of finance. Fhe development and certification process for a new aircraft is investment intensive and time consuming. The lack of participation of institutional investors in the industry cuts off an essential source of long term funding. The sustained competition between a number of heterogenous technologies ensures a cautious approach from the government in backing any single technology. The aircrafts also have certification woes to consider. The evtols are a completely new category for certification. To endsure passenger safety and smooth commercial operations, wide variety of factors such as redundancy, catastrophic failures , etc. need to be systematically analysed and parameterised into a consolidatedindex. The data from test flights is to be collected and analysed across the various evtols being developed to come up with an adequate standard. EASA and FAA are already working on it. FAA has faced some issues in transition for certification mechanism for conventional VTOL's which would replicate themselves in evtol certification.

At this point a comprehensive framework can be traced out.The governments are not in a position to predict with any certainity approach, so an incentive based approach relying on the standard of feasibility.The first one to develop a feasible aircraft according to the specification cab be provided with waiver of airport charges. The certification standards can be categorised and graded. Itwould enable the companies to assess performance based on the stage

certain prototype has reached. This would also provide a standard for investors to measure performance & perhaps spurring investments The government and assist companies in late stages of certification to be commercial production ready with an option of at cost supply of the certified aircraft. With regards to environmental consideration on EVTOL policy should include firstly, The provision for free and encumbrance free land National Civil Aviation Policy, 2016, Section 13(iii) can be diverted to include sustainable vertiports. Amendment in associated laws like The Hazardous and Other Wastes (Management and Transboudary) Rules 2015, E-Waste Management Rules, 2016, and Battery Waste Management Rules, to include extensive recycling of the Hydrogen Fuel Cell and LI-ion batteries.

PRIVATIZATION AND COMMERCIALIZATION OF THE INDIAN SPACE SECTOR: CHALLENGES, OPPORTUNITIES AND LIMITATIONS

Sushant Arsh Massey Khalkho & Kanishka Singh

INTRODUCTION

Recently, ISRO announced the much-awaited Space Policy as well as the Space Activities Bill ("**the Draft Bill 2017**") to be in their final stages.[1] This brings a relief to the groups awaiting the 2017 Bill, which had been crawling through the approval process, in the pre-consultation stages, since 2017.The 2017 Bill is a one-of-a-kind effort, seeks to regulate space-related activities in India. It not only provides for a legislative mechanism for outer-space related commercial activity in India, but also seeks to facilitate a shift from the domestic-owned enterprise and move to the greater inclusion of the private sector in outer-space related activity in India.

Contemporary Developments as of 2021

There are numerous views on the Bill, both welcoming and critical, however, there is consensus that the space industry is proving to be a rapidly growing sector, with multifarious opportunities for new players. The growth of the sector till 2023 has been projected to be around 1.6 billion dollars.[2] In terms of import of space tech, India is fairly active, from 10% in terms of launch vehicle tech to 50% in

---

1 PTI, SPACE POLICY, SPACE ACTIVITIES BILL IN FINAL STAGES: ISRO CHAIRMAN THE ECONOMIC TIMES (2020), https://economictimes.indiatimes.com/news/science/space-policy-space-activities-bill-in-final-stages-isro-chairman/articleshow/76800775.cms (last visited Feb 15, 2021).

2 T E Narasimhan, *Pvt sector to get 70% of upcoming space projects worth up to $1.6 bn: Isro*, @BSINDIA, January 31, 2020, https://www.business-standard.com/article/current-affairs/pvt-sector-to-get-70-of-upcoming-space-projects-worth-up-to-1-6-bn-isro-120013100833_1.html (last visited Feb 15, 2021).

satellite related tech.[3] Recently, the government has also come up with initiatives to boost private sector participation in the space sector by creation of the Indian National Space Promotion and Authorization Centre ("**IN-SPACe**").[4]

IN-SPACe is a regulator as well as a facilitator, being the interface between the Indian Space Research Organization ("**ISRO**") and private sector.[5] Moreover, the draft Space Communications Policy 2020 ("**draft Spacecom Policy**") and draft Norms, Guidelines and Procedures for Implementation of Spacecom Policy 2020 have been released, succeeding the 1997 Satcom Policy. These focus on development of space assets, harnessing satellite capabilities to increase connectivity and increase involvement of Indian private companies in the space sector.[6]

These new changes have been introduced building upon the objectives of improving the research and development in the outer-space sector, keeping in mind India's ambition of expanding its space capabilities vastly. The draft bill 2017 carries immense importance in this regard as it has the potential to create the requisite legal environment for the successful implementation of the policy

---

3 Race for Space - Space Activities Bill, 2017: Commercialization of Space, INDIA CORPORATE LAW (2019), https://corporate.cyrilamarchandblogs.com/2019/05/race-for-space-activities-bill-2017-commercialization/ (last visited Feb 15, 2021).

4 TOI Q&A, *'Space Activities Bill reflects years of research … it will bring clarity and synergy to both Indian and f*, TIMES OF INDIA BLOG, September 29, 2020, https://timesofindia.indiatimes.com/blogs/the-interviews-blog/space-activities-bill-reflects-years-of-research-it-will-bring-clarity-and-synergy-to-both-indian-and-foreign-companies/ (last visited Feb 15, 2021).

5 Amitabh Sinha, IN-SPACE EXPLAINED: WHAT IT MEANS TO THE FUTURE OF SPACE EXPLORATION THE INDIAN EXPRESS (2020), https://indianexpress.com/article/explained/in-space-india-space-missions-private-participation-isro-6476532/ (last visited Feb 15, 2021).

6 SPACECOM POLICY-2020 AND SPACECOM NGP-2020 -SEEKING COMMENTS-REG. DEPARTMENT OF SPACE BEING THE ADMINISTRATIVE MINISTRY IN RESPECT OF SPACE ACTIVITIES IN, (2020), https://www.isro.gov.in/sites/default/files/draft_spacecom_policy_2020.pdf (last visited Feb 15, 2021).

programmes. It becomes necessary therefore to examine the draft Bill in detail to determine its possible impacts.

A CRITIQUE OF THE DRAFT SPACE ACTIVITIES BILL 2017

Starting from late November, the ISRO opened pre-legislative consultation process for the draft bill 2017. The 52 responses that have been reportedly collected identify a myriad of issues with the Bill and the language of the provisions. In order to create a consistent and efficient legal framework for outer-space it is necessary that the Bill be scrutinized and the questions regarding its provisions be addressed. In this regard, the paper examines and evaluated major individual provisions of the draft bill 2017.

Provisions on Scope and Application

The draft bill 2017 applies to all "*Governmental, non-Governmental or private sector*" entities that are "*registered and incorporated in India*", as well as being "*engaged in any space activity in India or outside India*".[7] Prima Facie the issue is that the Act only considers entities that are incorporated or registered in India, that are involved in any space activity inside or outside India. This has two potential connotations.

First, it potentially opens the government to the risk of being held liable for the actions of private entities with the slightest links to India. For instance, actions of an entity registered and incorporated in India providing its services to a foreign entity from an Indian base can be attributed to India. Especially considering that India is a signatory to the UN Convention on International Liability for Damage Caused by Space Objects of 1971 ("**Liability Convention**").

---

7 As per the Draft Bill 2017, s 1(3).

The Convention involves attributing liability to states if the objects are launched from "*their territory or facility*" it also includes liability for an entity that is not regulated by the State as well. However, India being a member-state of the Liability Convention 1971 would be fastened responsibility for being the 'launching State'[8] in the transaction, *irrespective of who launched it*,[9] *as long as the space objects launched from the jurisdiction or facility of aforementioned launching State*.[10] Herein, it is important to note the distinction between the 'launching State' and the 'State of registry'.

The Indian position goes against art 8 of Outer Space Treaty which holds that the state of registry and not the launching state which should exercise jurisdiction over a space object.[11] This issue needs expedited resolution if India wants to remain a preferred destination for launching satellites for other countries. Furthermore, the persistent use of the singular term 'launching State' through the text of the bill seems to imply that the bill does not envision the prospect of multiple States jointly launch a space object. In this matter, India would be well advised to follow the path shown by the liability convention which holds the launching states jointly *and* severally liable for any damage caused by the object.[12]

This therefore creates an issue. This also must be considered alongside the State responsibility under section 3 of supervising the

---

8 Convention on International Liability for Damage Caused by Space Objects 1971 ("Liability Convention 1971"), art I.

9 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies 1967 ("Outer Space Treaty 1967"), art VII provides that States are 'internationally liable for damage to another State … or its natural and juridical persons, if such damage is caused by their space objects'.

10 Liability Convention 1971, art VIII (emphasis added).

11 Outer Space Treaty 1967, art VIII.

12 Liability Convention 1971, art IV (and more particularly art V).

conduct of activities where "*India is the launching State for which a license has been granted*".[13] Using terminology similar to the Liability convention, this provision seemingly creates an internal inconsistency in contrast with the scope of application. A contrasting approach can be seen in the Australian act where "*Australian nationals*" carrying out space activity outside Australia require approval from the government.[14]

Second, conversely, the provision might also limit private sector involvement in India as it does not allow foreign investment in the space sector, thereby limiting the government's vision of increasing investment into the outer-space sector. This goes against the spirit enumerated in sections 3 and 4, which indicate that the government only wants to regulate the sector, leaving the commercial sector to grow.

The Definition Provisions and Commercial Interests

Under the draft bill 2017, government authorization is required for any "*commercial space activity*".[15] Under s 2, the same is defined as "*a space activity which generates or is capable of generating revenue or profit*".[16] Given that this definition concerns the myriad of activities that the government seeks to control through its new policies and legislations, it is necessary to look at it from a critical lens. In this regard, the provision seems to have a visible drawback. The term becomes confusing in terms of its coverage as the scope of activity capable of generating revenue or activity having commercial potential is not clear. Further, the distinction between

13 Draft Bill 2017, s 3(k).
14 Space (Launches and Returns) Act 2018, part 3.
15 Draft Bill 2017, s 5.
16 Draft Bill 2017, s 2(a).

activities having commercial potential and other commercial activities is not made apparent.

In this regard the United States' definition of "commercial" provides a much clearer picture of the scope of activity. The definition mentions "*space goods, services, or activities provided by private sector enterprises that bear a reasonable portion of the investment risk and responsibility for the activity, operate in accordance with typical market-based incentives for controlling cost and optimizing return on investment, and have the legal capacity to offer these goods or services to existing or potential non-governmental customers*".[17]

This allows for a clear idea of the legislative intent to differentiate between activities with commercial potential and other commercial activities as well as remove ambiguity surrounding the section. Moreover, a further diversification can be made regarding the nature of products, such as between products made for use in space and those made for use on land involved in space-based activities such as communication devices, navigational products etc. This simplifies the regulation of products differing in terms of their position within the value chain usage and their nature of use.[18]

Additionally, in this regard, another drawback materializes in case of the definition of "*space activity*" under sub-clause (f) of Section 2 considered alongside sub-clause (a), which deals with the use of

---

[17] National Space Policy | Office of Space Commerce, COMMERCE.GOV (2020), https://www.space.commerce.gov/policy/national-space-policy/ (last visited Feb 15, 2021).

[18] Senjuti Mallickrajeswari and Pillai Rajagopalan, IF SPACE IS "THE PROVINCE OF MANKIND", WHO OWNS ITS RESOURCES? ORF (2019), https://www.orfonline.org/research/if-space-is-the-province-of-mankind-who-owns-its-resources-47561/ (last visited Feb 15, 2021).

"*space objects*". While this terminology is consistent with International Law standards,[19] it does exclude situations that might not concern the 'object', rather the activity itself. For instance in case of *in situ* mining, mining of resources will not be regulated *per se* under the definition. The definition also only recognizes such activity in cases where the object is "*launched*".[20] This excludes objects that might be assembled in space and not 'launched' per se. This is seen to be a prominent practice with technologies like 3D onsite printing.[21] Therefore, the purview of the definition needs to be re-evaluated.

Further, the definition of "*space activity*" is overbroad, considering it even includes procurement of such objects.[22] This includes procurement of even the communication components such as GPS and other communications services, which do not generally come under the purview of Space Regulatory bodies. This is a condition generally reflected in other jurisdictions such as the United Arab Emirates,[23] Luxembourg[24] and the United States.[25]

In this regard, to avoid instances where the government can be potentially held liable for a third party's actions, it has limited itself in terms of the areas it can regulate. In this regard, several changes

---

19 Outer Space Treaty 1967.

20 Draft Bill 2017, 2(g)(i).

21 Louis, 3D PRINTED SPACE OBJECTS AND THEIR LEGAL STATUS - SPACE LAW SPACE LEGAL ISSUES (2019), https://www.spacelegalissues.com/space-law-the-legal-status-of-objects-printed-in-outer-space/ (last visited Feb 15, 2021).

22 Draft Bill 2017, section 2(f)

23 The development of natural resources in outer space, JOURNAL OF ENERGY & NATURAL RESOURCES LAW (2019), https://www.tandfonline.com/doi/abs/10.1080/02646811.2018.1507343 (last visited Feb 15, 2021) 1, 23.

24 Law on the Exploration and Use of Space Resources 2017.

25 Space Resource Exploration and Utilization Act of 2015, CONGRESS.GOV (2015), https://www.congress.gov/bill/114th-congress/house-bill/1508 (last visited Feb 15, 2021).

can be affected, primarily requiring an amendment to be made to make the definition more exhaustive, possibly using "*includes*" preceding the listed activities. Additionally, a proviso can be added to the clause specifying the inclusion of an objected constructed in outer space to be within the purview of Government regulation.

Provisions on the Regulatory Environment – Regulators, Regulation and Policy Considerations

Regarding the Regulatory environment-the bodies and the mechanisms for the implementation of the draft Bill 2017, the draft merely states that the Central Government shall put into place the same.[26] While earlier it seemed that ISRO would be the body, the government created the IN-SPACE body as a separate regulator of the outer-space sector. This solves a primary criticism about the draft bill 2017, that there was no separate independent body to evaluate the commercial aspect of Space regulation.[27] Bodies like ISRO have an inherent conflict of interest if involved in the process;[28] therefore the inclusion of IN-SPACE provides a much-needed change to the outer-space regulatory framework.

However, even as a separate regulatory body, the functioning of IN-SPACe as a regulator is under question. Unlike other regulatory bodies like the Competition Commission or the Securities Exchange Bureau, IN-SPACe does not have a statutory framework regulating its actions as of now. Aside from the announcement of the

---

[26] Draft Bill 2017, s 3.

[27] Narayan Prasad, SPACE ACTIVITIES BILL, MEANT TO BOOST PRIVATE ROLE, WILL CREATE CONFUSION INSTEAD THE PRINT (2019), https://theprint.in/science/space-activities-bill-meant-boost-private-role-confusion/303950/ (last visited Feb 15, 2021).

[28] Explained: As India Loses Another Arbitration Case, the Ghost of Antrix-Devas Continues, THE WIRE (2018), https://thewire.in/government/india-isro-arbitration-antrix-devas (last visited Feb 15, 2021).

Department of Space ("**DoS**") Secretary, there are not many details available as of now.[29] However, it is necessary that for the body to be independent and effective, a proper statutory framework is created for its functioning. Inspiration may be taken from independent bodies such as NASSCOM (the trade association for the information technology industry),[30] for engendering a sustainable regulatory landscape for commercial space activities in India.[31]

Additionally, regarding the powers of regulation, the draft bill 2017 provides a wide range of powers to the Central Government to dismiss or revoke a license is a broad power given that the terminology used as to the grounds include "*interest of India*".[32] There are several questions that arise in this regard. Given that the powers of each body under the space regulatory regime are not clear, and the IN-SPACe body is in its formulative stages, it is unclear what body shall take licensing decisions in this regard. In any case the autonomy idea[33] which has been the background of the formation of IN-SPACe, can seemingly fail as the policy

---

29 T E Narasimhan, ISRO'S IN-SPACE TO BE SET UP AS SINGLE-WINDOW NODAL AGENCY FOR PVT SECTOR @BSINDIA (2020), https://www.business-standard.com/article/current-affairs/isro-s-in-space-to-be-set-up-as-single-window-nodal-agency-for-pvt-sector-120073001510_1.html (last visited Feb 15, 2021).

30 Narayan Prasad, SPACE ACTIVITIES BILL, MEANT TO BOOST PRIVATE ROLE, WILL CREATE CONFUSION INSTEAD THE PRINT (2019), https://theprint.in/science/space-activities-bill-meant-boost-private-role-confusion/303950/ (last visited Feb 15, 2021).

31 Narayan Prasad, SPACE ACTIVITIES BILL, MEANT TO BOOST PRIVATE ROLE, WILL CREATE CONFUSION INSTEAD THE PRINT (2019), https://theprint.in/science/space-activities-bill-meant-boost-private-role-confusion/303950/ (last visited Feb 15, 2021).

32 Draft Bill 2017, s 3 read with s 10(1)(c).

33 Business Insider India, IN-SPACE COULD BE SECTORAL REGULATOR ONCE LAWS ARE IN PLACE: SIVAN BUSINESS INSIDER (2020), https://www.businessinsider.in/science/news/in-space-could-be-sectoral-regulator-once-laws-are-in-place-sivan/articleshow/76625270.cms (last visited Feb 15, 2021).

background that is being utilized until now is as outdated like the 2000 SATCOM policy.[34]

After all, separate departments do not necessarily entail differing decision making until guided by specific policies and legislative framework. The seemingly vague grounds prescribed under the draft bill 2017, although not completely out-of-the-ordinary,[35] do nothing to ease this. Rather, after the *Antrix-Devas* issue,[36] it is high time that these grounds are more closely examined and made specific, removing ambiguities that might have existed.

In contrast, similar policies in other countries those deal with such as in the United States, where the National and Commercial Space Programs, a compilation of space laws deriving from the National Aeronautics and Space Act 1958, provides for a similar but more specific provision clarifying the grounds for revocation. The provision states "*the suspension or revocation is necessary to protect the public health and safety, the safety of property, or a national security or foreign policy interest of the United States*".[37] This provides a much more specific idea of the grounds, removing

---

[34] Ashok G.V., IF IN-SPACE IS THE ANSWER, WHAT IS THE QUESTION, AND WHY SHOULD YOU CARE? - THE WIRE SCIENCE THE WIRE SCIENCE (2020), https://science.thewire.in/spaceflight/isro-in-space-commercial-space-regulations-satcom-policy/ (last visited Feb 15, 2021).

[35] Space Affairs Act 1993| South African Government, WWW.GOV.ZA (2021), https://www.gov.za/documents/space-affairs-act# (last visited Feb 15, 2021), s 13(7) provides for similar provisions allowing the Minister of Trade and Industry to order the South African Council for Space Affairs 'to suspend or revoke a licence issued by the Council, if ... the licensed activity is in conflict with the interests of the State'.

[36] Explained: As India Loses Another Arbitration Case, the Ghost of Antrix-Devas Continues, THE WIRE (2018), https://thewire.in/government/india-isro-arbitration-antrix-devas (last visited Feb 15, 2021).

[37] U.S.C. TITLE 51 - NATIONAL AND COMMERCIAL SPACE PROGRAMS, GOVINFO.GOV (2011), https://www.govinfo.gov/content/pkg/USCODE-2011-title51/html/USCODE-2011-title51.htm (last visited Feb 15, 2021).

the ambiguity and consequently boosting the confidence of commercial players who might be deterred by vague provisions.[38]

Government Powers and Need for a Balanced Approach

The draft bill 2017 does not differ much in terms of its approach to government powers in terms of regulation compared to other legislations.[39] It provides sufficient discretion in terms of licensing provisions, prescribing licensing eligibility and so on.[40] However, this also carries the drawback of creating a barrier to entrants and decreasing investor confidence in the sector. The draft Bill provides grounds such as ensuring public health and safety, consistency with international obligations, ensuring sovereignty, integrity, security, defence, and preservation of international relations of India etc. as the eligibility criterion for grant of license.[41]

While these requirements are standard, however, they have to be framed from the lens of private entities looking to enter the sector. In this light the Bill notably misses out on the perspective of differing activities that take place in the space sector; these are generally divided into upstream and downstream activities.[42] These activities differ in terms of their nature and having a one-size-fits-all approach might not be best in terms of licensing in such a case. Therefore rules should be framed keeping in mind such business considerations; perhaps addressing these in the draft bill 2017 would

---

[38] Ranjana Kaul & Ram Jakhu, REGULATION OF SPACE ACTIVITIES IN INDIA 153-172 (2010), https://www.researchgate.net/publication/251159119_Regulation_of_Space_Activities_in_India (last visited Feb 15, 2021).

[39] MALAY ADHIKARI, LEGAL REGULATION OF PRIVATE ACTORS IN OUTER SPACE : INDIA'S ROLE 85 (2017).

[40] Draft Bill 2017, s 7.

[41] Draft Bill 2017, s 7(2).

[42] MALAY ADHIKARI, LEGAL REGULATION OF PRIVATE ACTORS IN OUTER SPACE: INDIA'S ROLE 85 (2017).

be best. Additionally, licensing must be implemented in the commercialization stage-before it is released in the market, to not deter research.[43]

On the other hand, further consideration is required in terms of expanding consideration of national security in the draft bill 2017. The need seems clear in case of the various issues that have taken place in recent past, for instance when Google Earth displayed vital military information on its database.[44] Moreover, as pointed out in point B, the Act does not comprehensively cover all space activity, this holds true in case of Section 6 and allied provisions as well. Licensing activities might also not be covered under the same. Therefore, in this case, making licensing compulsory for *all* private activities seems to be the most appropriate action. This also makes the Bill in line with the Outer Space Treaty of 1967.[45]

Attribution of Liability under the Draft Bill 2017

"*The legislature cannot delegate its function of laying down legislative policy in respect of a measure and its formulation as a rule of conduct. The Legislature must declare the policy of the law and the legal principles which are to control any given cases and must provide a standard to guide the officials or the body in power to execute the law*"

---

[43] Prabhjote Gill, INDIA'S NEW "SPACE ACTIVITIES BILL" WILL FIX THE LIABILITY FOR DAMAGE CAUSED IN OUTER SPACE BUSINESS INSIDER (2019), https://www.businessinsider.in/india-space-activities-bill-addresses-damage-in-outer-space/articleshow/69960212.cms (last visited Feb 15, 2021).

[44] Tarun Vijay, DRAWING THE LINE ON GOOGLE THE HINDU (2013), https://www.thehindu.com/opinion/op-ed/drawing-the-line-on-google/article4693193.ece (last visited Feb 15, 2021).

[45] Outer Space Treaty 1967, art VI and s 7.

This was held in the case of *Harishankar Bagla v. State of MP*[46] In this regard, the Bill ignores the fact that there has been no provision that dictates the clear broad policy of discretion in terms of providing licenses to entities that are not necessarily commercial, which makes the delegation excessive.[47] Further under Section 4 of the Act, the Government has abundant discretion to enquire or inspect any licensee *whenever* it deems "*expedient*" to do so.[48] This might lead to a situation where such power "*corrupts absolutely*".[49] There are no guidelines regarding the issuing of such an order or what "*expedient*" situations might entail. This needs to be clarified and appropriate clauses need to be added to create guidelines in this regard.

From an international perspective there can be several additions that can be made to this part. Collection of information on functioning in a manner similar to the Korean Act can be done where regular collection of data from licensees can be done, which might also lead to increase in participation.[50] With respect to monitoring a nodal officer on behalf of the government can be placed in these agencies, creating a uniform environment in compliance with jurisprudential standards, as is followed in the United States.[51]

This is even concerning given that liability mitigation is the most problematic feature under the Act. Generally, liability mitigation is

---

46 AIR 1954 SC 465 at ¶[12].

47 See *Jalan Trading Co (Private Ltd) v. Mill Mazdoor Union*, AIR 1967 SC 691, [1967] 1 SCR 15, MANU/SC/0185/1966 at ¶[78].

48 Draft Bill 2017, s 4(1).

49 DICTIONARY OF QUOTATIONS, 188 (1995).

50 SPACE DEVELOPMENT PROMOTION ACT, art 24 (2009), https://elaw.klri.re.kr/eng_service/lawView.do?hseq=17131&lang=ENG.

51 U.S.C. TITLE 51 - NATIONAL AND COMMERCIAL SPACE PROGRAMS, s 50907(a) GOVINFO.GOV (2011), https://www.govinfo.gov/content/pkg/USCODE-2011-title51/html/USCODE-2011-title51.htm (last visited Feb 15, 2021).

a standard feature under most international legislations.[52] While there are provisions for limiting State liability under the draft bill 2017, it is notably missing a standard feature of most of these international legislations that is, the insurance mitigation provision. For instance under the US law, minimum 500 million dollars insurance is required for third party activity and 100 million dollar insurance for private liability regarding space related activity.[53]

Above this limit, the government can provide compensation. This is done keeping in mind any damages occurring due to launches.[54] For instance SpaceX reportedly paid insurance worth 63 million dollars in terms of coverage for Falcon 9.[55] However, in terms of the Indian statute, liability is completely upon the private party, which serves to dissuade small or medium private players from investing in the sector. Even in other Indian sectors a similar model is followed for instance in the nuclear sector where there is a limit on operator liability.[56]

Additionally, in terms of liability and transparency, the draft Bill provides liability in terms of non-compliance with an "*order*".[57] When this is compared to Section 20, which provides for liability

---

[52] Paul Stephen Dempsey, National Laws Governing Commercial Space Activities: Legislation, Regulation, & Enforcement, 36 NORTHWESTERN JOURNAL OF INTERNATIONAL LAW & BUSINESS 1, 33 (2016).

[53] U.S.C. TITLE 51 - NATIONAL AND COMMERCIAL SPACE PROGRAMS, s 50907(a) GOVINFO.GOV (2011), https://www.govinfo.gov/content/pkg/USCODE-2011-title51/html/USCODE-2011-title51.htm (last visited Feb 15, 2021).

[54] Sandeepa Bhat, *Space Liability Insurance: Concerns and Way Forward*, 6 ATHENS JOURNAL OF LAW (2020), https://www.athensjournals.gr/law/2020-6-1-2-Bhat.pdf.

[55] Andy Pasztor, FAA MANDATING HIGHER INSURANCE COVERAGE FOR SPACEX ROCKETS WSJ (2017), https://www.wsj.com/articles/faa-mandating-higher-insurance-coverage-for-spacex-rockets-1489445055 (last visited Feb 15, 2021).

[56] THE CIVIL LIABILITY FOR NUCLEAR DAMAGE ACT, s 6 PRSINDIA (2010), https://www.prsindia.org/billtrack/the-civil-liability-for-nuclear-damage-bill-2010-1042 (last visited Feb 15, 2021).

[57] Draft Bill 2017, ss 4(1) and 4(2).

for contravention of a "*direction*"[58] question arises whether the two are the same. In case that is true, this requires prescription of differing damages or remedies in terms of the offence committed. Moreover, similar to the previous discussion, Section 20 also clearly is an excessive delegation as it carries no policy guideline to clarify what a contravention should entail. This creates the same issue as Section 4 and requires clarification as to the definition of "*direction*" as well as guidelines for what constitutes contravention.

Commercial Space Activity Licensing Requirements and Exemption of Licensees by Central Government

The Outer Space Treaty 1967 requires that appropriate State party to authorize non-governmental entities.[59] However, u/s 6(2) the Government has extensive discretion to exempt "***any*** *person or space activity*" from requiring authorization *via* a notification in accordance with India's international obligations.[60] The bill very emphatically falls afoul of the stipulations in Outer Space Treaty 1967.

Furthermore, there is a need to restrain extensive discretionary powers of the Central Government to allay concerns of excessive delegation u/s 6(2). This may be achieved by laying down a specific guidelines or policy objectives to be followed in exercising *discretion* though administrative fiat. Another complementary step would be for exemptions to only be allowed for government entities, rather than private applicants.

Again, a plain reading of s 13 seems to use two different words for the same function namely "*authorisation*" u/s 6 or "*licence*" u/s 8

[58] Draft Bill 2017, s 20.
[59] Outer Space Treaty 1967, art VI.
[60] Draft Bill 2017, s 6(1)(b).

Since the general understanding in interpretation an construction of statutes is that if 'two different words are used by the same statute, then *prima facie* one has to construe these different words as carrying different meanings'.[61] The synonymous use of the two terms leads to confusion e.g., s 6 titled "*Prohibition of unauthorized space activity*", also refers to prohibition on *unlicensed* activities, unless *such authorization* is exempted by the Government of India. Thus it is advisable for the legislature to maintain uniformity in the terms of reference.

Terms and Conditions in Licensing Requirements Providing for Backdoor Access to the Central Government

Another major concern of the Indian space industry pertains to the all encompassing nature of 'unconditional permission' obtained by the Central government from license applicant to inspect "***any*** *space activity and the material used*"in premises or manufacturing or assembling place of license applicant.[62] Over-broad scope of inspection(s) under this section makes it ripe for administrative overreach. Additionally, the absence of any reasonable, prior notice or consultation or prior hearing provisions (in line with PNJ imperative),[63] before commencing inspection is also concerning. Huge investments in development of space technologies can only be ensured through predictable, prospective and consistent application of laws.[64]

---

61 P RAMANATHA AIYAR'S ADVANCED LAW LEXICON, 612 (2016).

62 Draft Bill 2017, s 8(2)(a).

63 *State of UP v. Maharaja Dharmander Prasad Singh*, 1989 AIR 997, 1989 SCC (2) 505, MANU/SC/0563/1989 at ¶[29] held that 'On a matter of such importance where the stakes are heavy for the *Lessees who claim to have made large investments on the project* and where a number of grounds require the determination of factual matters of some complexity, *the statutory authority should, in the facts of this case, have afforded a personal hearing to the lessees*' (emphasis added).

64 *SL Kapoor v. Jagmohan*, 1981 AIR 136, 1980 SCC (4) 379, MANU/DE/0201/1980.

Thus, what is needed is to lay down requirements of prior consultation and notification where inspections are being carried *between sovereign* nation-states at the very least. This shall be in compliance with India's international space obligations.[65] This position on notice and consultation read with the *travaux preparatoires* of the Treaty reminds States to address due concerns of safety of space installations, and humans working therein.[66]

Thus the bill can be made robust by further recognizing the ultra-hazardous nature of carrying out inspections in Outer Space (if indeed such a broad formulation of inspection can be read as part of the legislative intent of parliament).[67] SOPs are thus required before undertaking any such inspections under delegated legislation at the very least. This shall ensure that inspections are carried out in the safest way possible.

Affixing Liability for Indemnification and Space Object Registration

Under the bill, the Central Government is authorized to determine the quantum of indemnity liability to be borne by the licensee for space object covered under the licence or damage or loss caused during commercial space activity.[68] The section uses the phraseology – "*in the manner as may be prescribed*". This allows for uncanalized discretion to be exercised by the Central

---

65 Outer Space Treaty 1967, art XII.

66 Comm on the Peaceful Uses of Outer Space, Legal Subcomm., Rep. on its 5th Sess., 63rd mtg., July 20, 1966, 5, UN Doc. A/AC.105/C.2/SR.63 (20 October 1966); Comm. on the Peaceful Uses of Outer Space, Legal Subcomm., Rep. on its 5th Sess., 64th mtg., July 21, 1966, 8, UN Doc. A/AC.105/C.2/SR.64 (24 October 1966).

67 Wilfred C Jenks, LIABILITY FOR ULTRA-HAZARDOUS ACTIVITIES IN INTERNATIONAL LAW (VOLUME 117) BRILLONLINE.COM 99 and 147(2015), https://referenceworks.brillonline.com/entries/the-hague-academy-collected-courses/*A9789028615427_02 (last visited Feb 15, 2021).

68 Draft Bill 2017, s 12.

Government which disregards international obligations to calculate liability and thus opens India up to unnecessary future litigation(s).

The Liability Convention 1971 on the other hand holds the State party absolutely liable for all the damage caused on earth,[69] but for damage caused in Outer Space, holds the State only liable to the extent of its fault.[70] However, in contemporary India, the bill only proposes a general indemnification of the Government of India by the offending licensee without any indication of a joint State and Non-State Liability sharing clause.[71]

Therefore, it is suggested that the grounds for deciding compensation be kept in line with international law and in doing so the legislature is accordingly advised to delete s 12(2) and substitute it with the following- "***s 12(2)(a)*** *- Notwithstanding anything contained in sub-section (1), the licensee shall be absolutely liable for damage caused, as a result of the licensed space activity or space object, on earth*' and '***s 12(2)(b)*** *- Notwithstanding anything contained in sub-section (1), the licensee shall be liable for the damage caused, as a result of the licensed space activity or space object, in Outer Space only to the extent of its fault.*"

However, even after being a signatory to UN Treaties on Outer Space activity,[72] India's space policy currently also does not cover

---

69 Liability Convention 1971, art 2.

70 Liability Convention 1971, art 3.

71 Kunwar Surya Pratap, Lavanya Pathak and Biswanath Gupta, WITH IN-SPACE IN THE PICTURE, WHAT IS THE SPACE ACTIVITIES BILL'S PLACE? - THE WIRE SCIENCE THE WIRE SCIENCE (2020), https://science.thewire.in/spaceflight/with-in-space-in-the-picture-what-is-the-space-activities-bills-place/ (last visited Feb 15, 2021).

72 ET Bureau, NEW SPACE BILL TO HAVE COVER FOR MISHAPS THE ECONOMIC TIMES (2019), https://economictimes.indiatimes.com/small-biz/startups/newsbuzz/new-space-bill-to-have-cover-for-mishaps/articleshow/69967043.cms (last visited Feb 15, 2021).

liabilities for damage to third party space assets.[73] This required a relook at understanding regarding risk distribution between Indian private players and Central Government, for liabilities arising from space activities.[74] S 10 of the United Kingdom's Outer Space Act 1986 ('OSA')[75] earlier required UK-based license applicants to indemnify the UK Government, without specifying an upper limit, against any and all damage or loss.[76] The Deregulation Act 2015 thereafter capped the maximum indemnity liability of licensees,[77] and is now specified in their licence.[78]

At present, in line with OSA, s 12(2) read with s 36 of Space Industry Act 2018 empowers the UK government to limit indemnity liability of operator. Furthermore the UK Government has a twin duty to (i) indemnify an operator for claims against it that exceed their insurance cover[79] and (ii) indemnify a claimant where injury or damage exceeds an operator's limited liability.

---

[73] ET Bureau, NEW SPACE BILL TO HAVE COVER FOR MISHAPS THE ECONOMIC TIMES (2019), https://economictimes.indiatimes.com/small-biz/startups/newsbuzz/new-space-bill-to-have-cover-for-mishaps/articleshow/69967043.cms (last visited Feb 15, 2021).

[74] Vidhi Bubna, THE UPCOMING SPACE ACTIVITIES BILL IN INDIA AND WHAT IT NEEDS TO ADDRESS MODERN DIPLOMACY (2020), https://moderndiplomacy.eu/2020/09/11/the-upcoming-space-activities-bill-in-india-and-what-it-needs-to-address/ (last visited Feb 15, 2021).

[75] OUTER SPACE ACT, s 10 (1986), https://www.legislation.gov.uk/ukpga/1986/38/pdfs/ukpga_19860038_en.pdf (last visited Feb 15, 2021).

[76] Satish C Shastri & Madhu Shastri, *Space Law with Special Reference to Space Debris*, *in* CURRENT DEVELOPMENTS OF INTELLECTUAL PROPERTY CREATED IN OUTER SPACE 415 (2012), http://nludelhi.ac.in/download/publication/2015/Current%20Developments%20in%20Air%20and%20Space%20Law.pdf.

[77] Deregulation Act 2015, s 10(1A).

[78] Deregulation Act 2015, s 5(3).

[79] SPACE INDUSTRY ACT (2018), s 35(2) https://www.legislation.gov.uk/ukpga/2018/5/contents/enacted (last visited Feb 15, 2021).

Thus, it is advised that in India, either s 12 be revised to account for an upper limit on indemnity liability of private player in India or the regulations under the bill make provisions for a private player's licence to specify a limit on the amount of the licensee's liability under this section or otherwise. Government participation in indemnification of private entities is also advised in line with the path shown by UK.[80] This is certainly not the first time India has prescribed a cap on liabilities through legislation.[81]

Restriction on any Person from Disclosing any Information Related to Space Activity or Space Object

Again, allowing "***any*** *officer, authority, organization, company or agencies*" subordinate to the Central Government, to be restricted from disclosing information on space activities is problematic.[82] The overbroad phraseology without any qualifications of the officer, authority, organization, company or agencies may lend itself to easy misuse. It is suggested that since there is judicial precedent wherein clothing 'any' official with broad sweeping powers was not allowed, it is more likely that the s 17 may be struck down for excessive delegation.[83] It is better to qualify the term any with 'designated' to prevent uncanalized and unguided exercise of power.

---

[80] *See* Joanne Wheeler MBE & Vicky Jeong, IN REVIEW: SPACE LAW, REGULATION AND POLICY IN UNITED KINGDOM LEXOLOGY.COM (2019), https://www.lexology.com/library/detail.aspx?g=dfc3dca9-d4be-445d-8c62-74167f0f35fc (last visited Feb 15, 2021).

[81] As aforementioned for The Civil Liability for Nuclear Damage Act 2010, s 6 PRS INDIA https://www.prsindia.org/billtrack/the-civil-liability-for-nuclear-damage-bill-2010-1042 (last visited Feb 15, 2021).

[82] Draft Bill 2017, s 17.

[83] In *Mega Cabs Private Limited v. Union of India*, 2016 SCC OnLine Del 3630, MANU/DE/1408/2016 at ¶[35], the Court stated, *'any officer' could not be interpreted mean any and every officer of the Service Tax Department but only those designated to so as it would otherwise suffer from the vice of excessive delegation*. Hence, the Court read down the discretion granted in the provision in order to uphold the presumption of constitutionality (emphasis added). Again, as per *Satchidananda Mukherjee v. State*

IPR Claims under the Draft Bill 2017[84]

Space aspiring nations (rightfully) want to protect their IP rights in space. Problems arise when jurisdictionally-based IP rights are sought to be enforced in outer space.[85] Presently, outer space treaties, conventions, and principles have observable gaps in protections of IPR in outer space.[86] The intellectual and financial value of sophisticated space technologies is enormous. Collaboration with private sector by state-owned space agencies is paramount for acquiring requisite financial and technical resources to support such activities.[87]

On their part, private commercial investors require intellectual property rights over products of their intellectual labour to sustainably acquire external financing and generate income from their investments.[88] Thus, the argument is that commercial

of West Bengal, (2) 64 CWN 521 at ¶[6], a provision for delegation of authority under the West Bengal Soft Coke Distribution Order 1955 was struck down as it was '*wholly unreasonable to allow this power to be exercised by any and every person who the Director might be pleased to clothe with authority*' (emphasis added).

84 [Note: *The discussion in this subheading shall concentrate on the study of the bill w.r.t. patent protection in outer space. The sub-heading does not deal with all rights defined in the WIPO Convention but limits its scope to rights arising from space activities and space technology. It is the claim of this article that challenges in securing patent protection are symptomatic of the larger problems w.r.t. IPR protection under the bill*].

85 Ritesh Mehra, *Intellectual Property Protection in Outer Space – An Overview*, 2 ILI LAW REVIEW 144 (2019), http://ili.ac.in/pdf/rm.pdf (last visited Feb 15, 2021).

86 Refer to Bill Warners, Patents 254 Miles up: Jurisdictional Issues Onboard the International Space Station, 19 UIC REVIEW OF INTELLECTUAL PROPERTY LAW 365, 365-380 (2020) elaborates on how international instruments like Outer Space Treaty does not explicitly mention protections granted to intellectual property, Registration Convention focuses on the ownership of space objects rather than intellectual property claims and the Liability Convention circumvents the issue of patent infringement (especially private third-party patent infringement) due to its restrictive definition of 'damage'.

87 Aakanksha Mishra, The Great beyond: Understanding Patents in Outer Space, 7 INDIAN JOURNAL INTELLECTUAL PROPERTY LAW 85, 85 (2014-2015).

88 KD Raju, *Issues in Protection of Intellectual Property Created in Outer Space: An Indian Outlook*, *in* CURRENT DEVELOPMENTS OF INTELLECTUAL PROPERTY CREATED IN OUTER SPACE 224 (2012),

enterprises' devoid of the *raison d'être* for their investment,[89] would demur from potentially exorbitant and risky investment in outer space,[90] which jeopardizes development of privatization and commercialization of space technologies and activities.[91] It is therefore imperative that intellectual property rights over inventions shouldn't be monopolized by the State while carrying out the space activities.

However, this is exactly what the Indian bill seems to have done by way of s 25. The section basically deems all forms of IPR "*developed, generated or created*" onboard a space object (like the International Space Station, etc) in outer to be the property of Government of India.[92] This is problematic. Even though the Outer Space Treaty 1967 pins responsibility and risks for activities of State and non-State actors onto the Government, this is still not a justification for the Government to subsume all intellectual property rights developed in outer space.[93] Given the all-encompassing phraseology of sub-clause 2, there seems no scope for private licensees to retain any form of IPR.

---

http://nludelhi.ac.in/download/publication/2015/Current%20Developments%20in%20Air%20and%20Space%20Law.pdf. (last visited Feb 15, 2021).

89 Yun Zhao, Intellectual Property Protection in Outer Space: Reconciling Territoriality of Intellectual Property with Non Territoriality in Outer Space, 7 QUEEN MARY JOURNAL OF INTELLECTUAL PROPERTY 137, 140 (2017).

90 Yun Zhao, Intellectual Property Protection in Outer Space: Reconciling Territoriality of Intellectual Property with Non Territoriality in Outer Space, 7 QUEEN MARY JOURNAL OF INTELLECTUAL PROPERTY 137, 141 (2017).

91 KD Raju, *Issues in Protection of Intellectual Property Created in Outer Space: An Indian Outlook*, *in* CURRENT DEVELOPMENTS OF INTELLECTUAL PROPERTY CREATED IN OUTER SPACE 224 (2012), http://nludelhi.ac.in/download/publication/2015/Current%20Developments%20in%20Air%20and%20Space%20Law.pdf. (last visited Feb 15, 2021).

92 Draft Bill 2017, s 25(2); Also see FRANCIS LYALL & PAUL B LARSEN, SPACE LAW: A TREATISE 124 (2009).

93 Outer Space Treaty 1967, art VI.

Furthermore, u/s 25(1), term 'national interest' is over-broad and left undefined. This is a cause for concern[94] since this gives the State unilateral power to appropriate IPR to them.[95] For a way forward we may have to look across the Atlantic the United States' Space Act, which allows the Government to only retain a non-exclusive, royalty free licence to space inventions for Government use and the 'march in rights' in case the contractor does not develop the invention.[96] The Indian Bill should similarly provide for a broad licensing mechanism (instead of ownership) or provide compensation to the private licensee for use of their IPR.

s 25 would do well to take inspiration from the US Patent Code, s 105(a)[97] which stipulates that, 'Any invention made, used or sold on a space object or component thereof under the jurisdiction or control of the US ***shall be considered to be made, used or sold within the US***.' A similar provision in the Indian draft bill would allow private licensees to retain their IPR while subsuming said IPR under Indian laws *via* deeming fiction.

On the other hand, in cases of invention made, used or sold in outer space on space objects registered under a foreign State, s 105(b) allows for an international agreement to be effected between the US and foreign State to deem such inventions to be made, used or sold within the US. Adoption of provisions like s 105(b) is imperative, considering that collaborative and joint ventures in space technology by consortium of countries shall become more commonplace with

---

94 Draft Bill 2017, s 25(1).

95 Similar concerns ware also highlighted during the reading of s 3 with s 10(1)(c).

96 Barbara Luxenberg & Gerald J Mossinghoff, Intellectual Property and Space Activities, 13 JOURNAL OF SPACE LAW 8, 11 (1985), https://digitalcommons.unl.edu/spacelawdocs/6/ (last visited Feb 15, 2021).

97 35 U.S. CODE - INVENTIONS IN OUTER SPACE, s 105 LII / LEGAL INFORMATION INSTITUTE (2021), https://www.law.cornell.edu/uscode/text/35/105 (last visited Feb 15, 2021).

commercialization of space activities.[98] It would thus be prudent for parties to *ex ante* agree upon entitlement of IPR before engaging in space activities and expeditions.

CONCLUSION

The Draft Space Activities Bill 2017 brings a much-needed revolution in the space sector in India that has been long pending. Although the Bill introduces a lot of laudable changes, as discussed in the essay however, it does contain problematic provisions as well. The 2017 Bill is not infallible, it contains ambiguous provisions, archaic licensing, fallible liability provisions and unclear policy backing, all of which create the impression that while a laudable effort, the act is nowhere near completion and needs changes to be made in its final version.

The conclusion that is therefore drawn after closely analyzing and critiquing the various provisions in the draft Bill, is that if the Bill is passed the way it stands, it would not be effective in its goal of efficiently attracting private players in the outer space sector. The major critiques stem from the point that the Bill is not outward looking in its provisions, that it does not anticipate and address developments that have currently been gaining prominence and might become the norm in the future. In this regard, it is also noticed that the act does give national interest, sovereignty and other national consideration more prominence and does not adequately address and account for the private sector considerations.

Moreover the gaps and the fallacies in the Act might also lead to certain potential concerns for the state itself, even involving

---

[98] KD Raju, *Issues in Protection of Intellectual Property Created in Outer Space: An Indian Outlook*, *in* CURRENT DEVELOPMENTS OF INTELLECTUAL PROPERTY CREATED IN OUTER SPACE 224 (2012), http://nludelhi.ac.in/download/publication/2015/Current%20Developments%20in%20Air%20and%20Space%20Law.pdf. (last visited Feb 15, 2021).

potential litigation, which as we have seen in the *Antrix* situation, does not result well. There also seems to be a need for a more nuanced legislation with different types of space activities being covered under individual sections for remote sensing, launch vehicles, spacecraft and operations, space resource utilisation, etc and separate regulations for each type of activity and players (like the US Commercial Space Launch Competitiveness Act) unlike the blanket Act we currently have.[99]

Again, setting up an institution dedicated to resolve space activities and technologies related arbitration in India akin to idea mooted in US may be considered as well.[100] Therefore, in order to make sure that the space sector is revolutionized and progress is from this point onwards the draft bill needs to be amended to a large extent, especially given that the Bill and eventually the Act is supposed to chart new pathways in the Indian space sector and create more opportunities. In order to do so it cannot be inward looking and needs to be created with sufficient forethought taking into account international best practices and scientific developments of the day globally.

---

[99] Narayan Prasad, SPACE ACTIVITIES BILL, MEANT TO BOOST PRIVATE ROLE, WILL CREATE CONFUSION INSTEAD THE PRINT (2019), https://theprint.in/science/space-activities-bill-meant-boost-private-role-confusion/303950/ (last visited Feb 15, 2021).

[100] Juan Felipe Jimenez, Patents in Outer Space: An Approach to the Legal Framework of Future Inventions, 98 JOURNAL OF THE PATENT AND TRADEMARK OFFICE SOCIETY 447, 459-465 (2016).

OVERBOOKING: THE COSTS OF PROFITABILITY

Jacomo Restellini

INTRODUCTION

In April 2017, United Airlines made the headlines after deporting a passenger of a Chicago-Louisville flight. The images of the incident show three security guards grabbing a passenger already seated in his seat to get him out of the plane. The man screams, hits himself and is dragged to the ground to be removed from the aircraft. He finally manages to get back on board, repeating over and over again: "I have to go home". The flight 3211 took off two hours late, without the passenger in question who had been disembarked. Minutes before the incident, passengers were told that there were more passengers to transport than there were seats available on the plane.[1]

Incidents as described above remain marginal in air transport, notwithstanding the fact that the economic practice from which they arise, namely 'overbooking', is widely used by airlines.[2] It is common for airlines to overbook their scheduled flights, *i.e.* intentionally sell more seats than there are available in order to compensate passengers who do not show up for boarding.[3] However, things become problematic when all ticketed passengers cannot be carried on a flight and are denied boarding. This is known as 'voluntary' or 'involuntary' denied boarding, depending on whether or not the passenger agrees to give up his seat.[4]

---

1 Daniel Victor and Matt Stevens, *United Airlines Passenger is Dragged from an Overbooked Flight*, THE NEW YORK TIMES, April 10, 2017, at A1.

2 Patrick Doussot, *Air France KLM*, ANNUAL REPORT 2009/2010 (Feb. 2, 2021, 12:02 PM), https://www.airfranceklm.com/sites/default/files/publications/af_klm_ra_09-10-ra-complet_gb_bat_page_a_page_10-0.pdf.

3 United States Government Accountability Office (GAO), *Report to Congressional Committees: Airline Consumer Protections: Information on Airlines' Denied Boarding Practices, at 1* (Feb. 2, 2021, 12:02 PM), https://www.gao.gov/assets/710/703083.pdf.

4 *Id.*

Between 1990 and 2019, denied boarding declined significantly among the largest US air carriers. In 1990, 0.15% of passengers were denied boarding, either voluntarily or involuntarily. By 2019, this figure had dropped to 0.06%.[5] Despite these declining numbers, denied boarding remains an unpleasant experience that can have negative financial consequences for passengers. The practice therefore deserves to be analyzed.

This paper starts by defining the model of overbooking, its main characteristics and the reasons that push airlines to use it (1.). Then, it assesses whether this practice falls within the scope of international private air law (2.), before looking at the salient features of the EU and US legislation on passenger compensation for denied boarding (3.). Finally, this paper discusses the issue of liability between air carriers and passengers when overbooking, respectively denied boarding, occurs in the context of code-share flights (4.).

THE PRACTICE OF OVERBOOKING

Definition of overbooking

Overbooking is an economic practice purposefully used by airlines to optimize their operating results. It consists of accepting more reservations than the actual seating capacity available on a flight, with the expectation that there will be a sufficient number of cancellations or withdrawals by departure time to avoid denied

[5] US BUREAU OF TRANSPORT STATISTICS, *Passengers Boarded and Denied Boarding by the Largest U.S. Air Carriers*, February 2020, (Feb. 2, 2021, 12:02 PM), https://www.bts.gov/content/passengers-boarded-and-denied-boarding-largest-us-air-carriersathousands-passengers. *See also* Elena Mazareanu, *Passengers denied boarding by the largest U.S. air carriers 2000/2019*, STATISTA (Feb. 2, 2021, 12:02 PM), https://www.statista.com/statistics/186198/passengers-voluntary-and-involuntary-not-boarded-since 1990/.

boarding with the passenger compensation costs it entails.[6] Airlines sell perishable inventory and wish to fill every available seat with a "warm, fare paying derriere".[7] When an airline decides to provide service on a certain route, its costs are fixed and once a flight takes off, the value of unsold seats is lost forever.[8]

Causes of overbooking

Overbooking responds to a widespread practice among passengers, namely that of making a reservation in order to guarantee a seat on the plane, but not to present themselves for boarding.[9] This practice, commonly referred to as a 'no-show'[10], is mainly explained by the fact that (*i*) in principle, full fare airline tickets give the passenger the right to decide not to show up without penalty[11] and (*ii*) some passengers who have booked a return flight - cheaper than a one-way ticket - do not bother to show up for the return trip.[12] Using statistics, carriers try to predict the number of no-shows based on factors specific to a passenger or a flight. However, this method is not infallible and sometimes, more passengers than there are seats

---

6 International Civil Aviation Organization, *Manual on the Regulation of International Air Transport* (2d ed. 2014), at 4.2-5 and 4.2-6.

7 Alison Nathaniel, *Comparative Analysis of Passenger Protection in the Aviation Industry: The Need for Reform in Canada*, 40 Annals of Air and Space Law 845, 852 (2015).

8 Elliott Blanchard, *Terminal 250: Federal regulation of airline overbooking*, 79(5) New York University Law Review 1799, 1802 (2004).

9 Dimitris Liakopoulos, *Jurisprudential Approach of the Aircraft Liability according to International and EU Rules*, 12(1) Acta Universitatis Danubius: Relationes Internationales 137, 160 (2019).

10 Steve Mirmina, *Overbooking and Denied Boarding Compensation: the approaches of the European Union and United States*, 11 Air and Space Lawyer 1, 7 (1996).

11 Blanchard, *supra* note 8, at 1804.

12 Simon Calder, *Travel - The complete guide to holiday rights*, THE INDEPENDENT, November 4, 2000, at 3.

available may present themselves for boarding, forcing the carrier to deny boarding to some passengers.[13]

Advantages and disadvantages of overbooking

Overbooking makes it possible to avoid - as long as the airline's predictions are correct - that a passenger cannot buy the flight of his choice even though seats on the plane would ultimately be empty. In addition, it allows airlines to maintain lower fares, because by preventing empty seats, airlines also prevent the cost of those empty seats from being passed on to other passengers' tickets. [14] From the airlines' perspective, overbooking is an important tool to better manage their inventory and avoid ending up in an unprofitable situation, namely with empty seats.[15]

Of course, the flip side of the coin is that if the airline's predictions are inaccurate, passengers are inevitably denied for boarding. The carrier is then in default towards them, with reference to the contractual obligation of transport, and is exposed to financial penalties.[16] For passengers, denied boarding means at the least dissatisfaction but very often consequent financial loss.[17] In itself, overbooking is not a problem; however, denied boarding is.[18] The next chapters will look at the rules governing air carrier's liability in case of denied boarding.

---

[13] Frédérique Jos, *Le régime de responsabilité du transporteur aérien international envers les passagers et les marchandises : mécanismes et évolution de la limitation* (1992) McGill University, at 46 (Feb. 2, 2021, 12:02 PM) https://escholarship.mcgill.ca/concern/theses/707958630?locale=en. *See* also GAO, *supra* note 3, at 5.

[14] International Civil Aviation Organization, *Overbooking*, Position paper (2017), (Feb. 2, 2021, 12:02 PM) https://www.iata.org/contentassets/2e46aace261040b9a47 fb7b9da18efc9 /overbooking.pdf. *See* also Doussot, *supra* note 2, at 63.

[15] GAO, *supra* note 3, at 20.

[16] Liakopoulos, *supra* note 9, at 160.

[17] Mirmina, *supra* note 10, at 7.

[18] *Id*. at 1.

THE LIABILITY OF THE AIR CARRIER

Delay or non-performance of the contract

Article 19 WC29 and MC99 expressly deals with the liability of the carrier in case of 'delay' in international transport.[19] However, neither the WC29 nor the MC99 explicitly mentions the term 'denied boarding', especially if it can be included in the notion of 'delay'. Court decisions are divided on this matter.[20] Nevertheless, the question remains central because if denied boarding constitute a 'delay', first the remedies are those mentioned under Article 22 MC99[21] and second, any proposed remedy under local law are prescribed under the 'however founded' language of Article 29.[22] On the other hand, if the MC99 is not applicable, claims for denied boarding damages are not pre-empted by the MC99, respectively the WC29, and may be subject to national or regional law for non-performance of the contract.[23]

Jurisprudence

In the case *Wolgel v. Mexicana Airline*, the United States Court of Appeals for the Seventh Circuit held that denied boarding amounted to a "total nonperformance of a contract" and, therefore, was not

---

[19] Convention for the Unification of Certain Rules for International Carriage by Air, signed at Montreal on 28 May 1999 (CM99) and Convention for the Unification of Certain Rules Relating to International Carriage by Air, signed at Warsaw on 12 October 1929 (WC29).

[20] George N. Tompkins, *"Bumping"-Denied Boarding - and Article 19 of the Montreal Convention*, 32(3) Air & Space Law 231, 231(2007). *See* also Jos, *supra* note 13, at 47.

[21] 5346 SDRs or more if the carrier engaged in willful misconduct under Article 22(4), or nothing if the carrier took "all measures that could reasonably be required to avoid the damage or that it was impossible for them to take such measures" under Article 19.

[22] Paul Stephen Dempsey & Svante O. Johansson, (2010), *Montreal v. Brussels: The Conflict of Laws on the Issue of Delay in International Air Carriage*, 35(3) Air & Space Law 207, 208-209 (2010). A last-minute rebooking on an alternative international flight, plus hotel and meals occasioned by the delay, may well exceed the MC99 amount (*i.e.* 5346 SDRs).

[23] *Id*. at 213. *See* also Mirmina *supra* note 10, at 7.

covered by Article 19 WC29.[24] In *Weiss v. Elal Israel Airline*, the US District Court also held that the MC99 was not applicable to a claim for damages based on denied boarding. After reviewing the *travaux préparatoires*, the Court noted that (*i*) the drafters of MC99 had decided to leave the definition of delay to national courts and (*ii*) the academic literature indicated that courts that had dealt with this issue in other signatory countries had almost uniformly accepted that denied boarding constitutes a breach of contract - and not a delay - compensable under local law.[25]

In *Paradis v. Ghana Airways*, the Court distanced itself from the Wolgel case by considering this time that "denied boarding" fell under the MC99, in particular because (*i*) the Paradis passenger had been denied during his return trip, whereas Wolgel passenger had been denied during his outward journey of a round trip, and (*ii*) alternative transportation had been offered to Paradis passenger, which had not been the case for Wolgel passenger.[26] In *Igwe v. Northwest Airlines*, the Court held that the plaintiffs who failed to check in on time had acted too quickly in rejecting the carrier's offers of conciliation to be able to rely on the airline's complete breach of contract.[27]

Synthesis

Courts tend to consider that denied boarding is not covered by the MC99 and the WC29 since it constitutes a breach of the international contract of carriage. This view is widely shared by the doctrine.[28]

---

[24] Wolgel v. Mexicana Airlines, 821 F. Supp. (2d) 442, 444 (1987).
[25] Weiss v. Elal Israel Airlines Ltd, 433 F. Supp. (2d.) 361, 368 (2006).
[26] Paradis v. Ghana Airways Limited, 346 F. Supp. (2d.) 106, 109 (2004).
[27] Igwe v. Northwest Airlines, Inc. Civil action n. h-05-1423, 8 (2007).
[28] Liakopoulos, *supra* note 9, at 161; PABLO MENDES DE LEON, INTRODUCTION TO AIR LAW 212 (10th ed. Wolters Kluwer 2017); Dempsey & Johansson, *supra* note 21, at 214. *Contra* Tompkins *supra* note 19, at 231.

However, in specific circumstances, in particular when the passenger has been offered alternative transportation, some courts have considered that the MC99 may be applicable. In the author's view, denied boarding should not be considered as a delay, even when an alternative transportation is offered to the passenger. Indeed, only the carrier's decision is relevant - that of refusing the passenger on the agreed flight - and not the consequences of that decision, *i.e.* the fact that the passenger ultimately arrives late at his destination. Otherwise, the carrier could simply offer another flight to the passenger - even for many hours later - to "erase" the denied boarding and thus benefit from the liability limits of the MC99.[29]

Such unpredictability has led to calls for a unified system of rules regarding airline liability for overbooking.[30] The next chapter will briefly discuss EU and US legislations on air carrier's liability for denied boarding through a comparative approach.

THE LEGAL SOLUTIONS IN EUROPE AND THE US

European Union: Regulation 261/2004

Scope of application

Regulation 261/2004[31] applies to all passengers (*i*) departing from an EU airport and (*ii*) departing from airports outside the EU to an EU airport, provided that the flight is operated by a community carrier and the local legislation of the non-member state from which the flight departs does not provide for similar measures.[32]

---

[29] For the purposes of this paper, it is assumed that neither WC29 nor MC99 are applicable to denied boarding.

[30] Mirmina, *supra* note 10, at 7.

[31] Regulation (EC) No 261/2004 of the European Parliament and of the Council of 11 February 2004 establishing common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delay of flights.

[32] Article 3 (1) (a) and (b) Regulation 261/2004.

Regulation 261/2004 does not cover passengers for flights arriving from outside the EU on non-EU carriers. Also, the CJEU considers that the notion of flight should not be confused with the notion of journey and that in the case of a return flight, the return flight should be assessed as such for the application of Regulation 261/2004.[33]

Denied boarding

Under Regulation 261/2004, denied boarding means that a carrier refuses to carry a passenger on a flight, unless there are reasonable grounds for such a denial, including, but not limited to, inadequate travel documentation, health, safety or security.[34] This rule applies in particular to overbooking situations.[35] In the case *Finnair v. Lassooy*, the CJEU stated that Regulation 261/2004 covers all circumstances in which the carrier might refuse to transport a passenger *i.e* "not only cases where boarding is denied because of overbooking but also where boarding is denied on other grounds, such as operational reasons" (*in casu* a flight reorganization).[36]

In case of denied boarding, a two-step procedure is provided for. First, the air carrier must find volunteers who agree to give up their seat in return for compensation negotiated with the airline (hereinafter: "Voluntary Refusals"). If there are not enough Voluntary Refusals, the air carrier may refuse passengers against

---

[33] CJEU, Case C-173/07, Emirates Airlines - Direktion für Deutschland v Diether Schenkel, judgment of 10 July 2008, ECLI:EU:C:2008:400, n. 53.

[34] Article 2 (j) Regulation 261/2004. *See* also Ieva Deviatnikovaitė, *The Montreal Convention of 1999 and Regulation No 261/2004 in the EUCJ and National Case Law*, 11(1) Baltic Journal of Law & Politics 21, 37 (2018).

[35] SYLVAIN MARCHAND, DROIT DE LA CONSOMMATION : LE DROIT SUISSE À L'ÉPREUVE DU DROIT EUROPÉEN 267 (Schulthess 2017).

[36] CJEU, Case C–22/11, Finnair Oyj v Timy Lassooy, judgment of 4 October 2012, ECLI:EU:C:2012:604, n. 22-26.

their will (hereinafter: "Involuntary Refusals").[37] Passengers who are subject to Involuntary Refusals benefit from three types of cumulative remedies.

Carrier's remedies in case of denied boarding

- *Financial compensation*

The amount of the financial compensation lump sum depends on (*i*) the distance of the flight and (*ii*) the time of arrival at the final destination in case of rerouting. The carrier must pay the passenger 250 EUR for flights of 1'500 km or less (hereinafter: "Short Flights"), 400 EUR for intra-community flights of more than 1'500 km and all flights between 1'500 and 3'500 km (hereinafter: "Medium Flights"), and 600 EUR for long-distance flights (hereinafter: "Long-Haul").[38] In case of re-routing, the amount of the lump-sum may be reduced by 50% if the arrival time does not exceed the scheduled arrival time of the flight initially booked by 2 hours for Short Flights, 3 hours for Medium Flights and 4 hours for Long Flights.[39]

In the event that the damage suffered by the passenger exceeds the compensation, the lump-sum may be supplemented by a claim for damages against the carrier based on national law.[40] In such a case, the compensation granted by Regulation 261/2004 must be deducted.[41]

- *Reimbursement and re-routing*

---

[37] Yuran Shi, *Further Compensation Rights in Cases of Overbooking Analysis of Article 12 of the EU Regulation 261 under Contract Law*, 2 The Aviation and Space Journal 2, 24 (2020).

[38] Article 7 (1) (a) - (c) Regulation 261/2004.

[39] Article 7 (2) (a) - (c) Regulation 261/2004.

[40] CJEU, Case C-83/10, Aurora Sousa Rodríguez and Others v Air France SA, judgment of 13 October 2011, ECLI:EU:C:2012:604, n. 36.

[41] Article 12 (1) Regulation 261/2004.

The air carrier must offer the passenger the following choices: (*i*) a refund of the ticket within 7 days and, if applicable, a return flight to the point of departure, (*ii*) re-routing to the final destination under comparable conditions of carriage at the earliest opportunity, or (*iii*) re-routing to the final destination under comparable conditions of carriage but at a later date to be agreed upon.[42]

The remedy provided by Article 8 is the only one available to the passenger of a Voluntary Refusal. Indeed, by accepting the denied boarding and the related compensation, the passenger can no longer claim compensation for the time he has chosen to lose or the cost of the food he has chosen to incur.[43]

- *Care*

The passenger is also entitled to receive free (*i*) meals and beverages commensurate with the waiting time, (*ii*) hotel accommodation when circumstances require it, including transportation from the airport to the hotel, and (*iii*) access to means of communication (two telephone calls, faxes or e-mails).[44]

US rules on overbooking

Scope of application

Denied boarding rules[45] apply to any carrier providing domestic or international air transportation originating in the United States, provided that the aircraft has more than 30 seats.[46] Thus, the rules

42 Article 8 (1) (a) - (c) Regulation 261/2004.
43 Article 4 (1) *cum* 12 (2) Regulation 261/2004.
44 Article 9 (1) and (2) Regulation 261/2004.
45 The Code of Federal Regulations (CFR), Title 14, Chapter II, Subchapter A, Part 250 (hereinafter: 14 CRF 250).
46 14 CFR 250.2.

apply to carriers regardless of their nationality or the passenger's nationality, focusing only on the passenger's point of departure.[47]

Denied boarding

Like the European regulation, in the event of overbooking, the carrier must first ask for volunteers to leave their seats in exchange for compensation agreed with the carrier.[48] When the number of volunteers is insufficient, the air carrier may deny boarding to passengers against their will based on priority rules established by the carrier. These rules must not be discriminatory in nature.[49]

Carrier's remedies in case of denied boarding

Contrary to Regulation 261/2004, compensation calculation is based on (*i*) the price of the ticket and (*ii*) the duration of the delay at the first stopover - or at the final destination - compared to the scheduled arrival time of the original flight.[50] If the air carrier provides alternative transportation to the final destination whose arrival time does not exceed the originally scheduled arrival time by more than one hour, no compensation is due.[51] If the arrival delay is between 1 hour and 2 hours for domestic flights or 1 hour and 4 hours for international flights, the carrier must pay a compensation corresponding to 200% of the fare at the first stopover - or at the final destination - up to a maximum of 675 USD. If the arrival delay is longer than 2 hours for domestic flights and 4 hours for international flights, the passenger is entitled to 400% of the fare at

47 Mirmina, *supra* note 10, at 8.
48 14 CRF 250b (a).
49 14 CRF 250.3 (a) - (b).
50 14 CRF 250.5.
51 14 CRF 250.5 (a) (1).

the first stopover - or at the final destination - up to a maximum of 1'350 USD.[52]

Contrary to the EU legislation, the air carrier has no obligation to pay compensation not only for safety or security reasons but also for operational reasons.[53] The passenger must be informed that the acceptance of the compensation may relieve the air carrier from any further liability to the passenger caused by its failure to honor the confirmed reservation. However, the passenger may decline the payment and seek to recover damages before court or in some other manner.[54] The passenger could, for instance, seek damages for breach of contract on the basis of national law. For international flights - if the carrier offers alternative transportation - the passenger could seek damages on the basis of international conventional air law.[55]

Synthesis

Both legislations ensure the same objective - protect the passenger subject to denied boarding due to overbooking - with more or less comparable financial compensation. That said, the US legislation appears to be more restrictive in that it allows the carrier not to pay any compensation (*i*) when the denied boarding is due to operational reasons[56], (*ii*) when the alternative flight arrives less than one hour late [57] and (*iii*) does not grant any right to care to the passenger. Furthermore, it should be pointed out that when a European carrier

---

52 14 CRF 250.5 (2) - (3).

53 14 CRF 250.5 (6). For example: replacement of the aircraft initially planned by a smaller aircraft or a weight balance restriction for an aircraft with less than 60 seats.

54 14 CRF 250.5 (9).

55 The author does not agree with this hypothesis: *Supra* note 28. *Contra* Dempsey *supra* note 21, at 216.

56 *Supra* note 52.

57 14 CRF 250.5 (1).

operates a flight between the US and Europe, the territorial scope of application of the two legislations may lead to overlaps that should be clarified.[58]

THE OVERBOOKING ISSUE IN CONNECTION WITH CODESHARING: EU- US PERSPECTIVE

Notion of codesharing and problematic

Code sharing is a practice by which one carrier permits a second carrier to use its airline designator code on a flight, or by which two carriers share the same airline code on a flight.[59] As a result, a flight operated by one airline is jointly marketed by several airlines.[60] The central element of code-sharing is that the airlines involved integrate their operations so that they can offer, under their own name, flights with their partners' aircraft.[61]

In practice, codesharing may lead to uncertainties regarding air carrier's liability.[62] In the particular context of liability for denied boarding, two issues must to be distinguished. First, which air carrier is responsible towards the passenger (the "Airline – Passenger Liability")? In certain situations, the carrier that sold the ticket may not be the one that denied boarding (*see* 4.2). Second, how do airlines divide the liability for denied boarding among themselves? Indeed, the carrier that compensates the passenger may

---

58 14 CFR 250.2 and Article 3 (1) (b) Regulation 261/2004.

59 International Civil Aviation Organization, *supra* note 6, at 4.8-2.

60 Ceren Savaser, *Overall analysis of code-share agreements in global markets*, 2013, (Feb. 2, 2021, 12:02 PM) https://www.mondaq.com/turkey/Transport/277128/Overall-Analysis-Of-Code-Share-Agreements-In-Global-Markets.

61 MENDES DE LEON, *supra* note 27, at 84-85.

62 International Civil Aviation Organization, *Implications of airlines codesharing*, Circular 268-AT/110, at 10, 1997, (Feb. 2, 2021, 12:02 PM) https://www.icao.int/sustainability/Documents/C269_en.pdf.

not be the one that overbooked the flight (the "Inter-Carrier Liability") (*see* 4.3).

Airline – Passenger Liability

General principle

Generally, the airline industry rules and practices assign the legal liability for compensating code-sharing passengers to the airline that operates the flight on which the passenger is denied boarding.[63]

Regulation 261/2004

Regulation 261/2004 follows this approach since according to Article 3, paragraph 5, the obligations under the Regulation remain with the operating carrier (hereinafter also: "actual carrier") and not with the air carrier that sold the ticket (hereinafter: "marketing carrier").[64] In the case of codeshare flights, this rule may be "unfair" if the denied boarding is the "fault" of the marketing carrier because it alone has sold more tickets than available seats. The parties would therefore be well advised to address this issue in their code-share agreement (*see* 4.3).

US regulation

Regulation 261/2004 does not apply to a codeshare flight between the US and Europe operated by an US airline, notwithstanding the

---

[63] Audrey Guelfi, *Implications of codesharing agreements on air carriers' liability (2000), at 51,* McGill University (Feb. 2, 2021, 12:02 PM), https://escholarship.mcgill.ca/concern/theses/kp78gj27x.

[64] Commission Notice - Interpretative Guidelines on Regulation (EC) No 261/2004 of the European Parliament and of the Council establishing common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delay of flights and on Council Regulation (EC) No 2027/97 on air carrier liability in the event of accidents as amended by Regulation (EC) No 889/2002 of the European Parliament and of the Council, at 2.2.3.

fact that said airline is the operating carrier.[65] In this scenario, the US denied boarding regulations apply.[66] Here, the problem is that the US regulations do not clearly designate which carrier - the marketing or operating carrier - is liable towards the passenger under a code-share flight. That said, it appears in practice that some US air carriers specify in their general conditions that in the case of code-share flights only the 'marketing carrier' is liable for denied boarding due to overbooking or the 'operating carrier' by reference to Regulation 261/2004.[67] By this contractual means, the marketing carrier, respectively the operating carrier, becomes liable toward the passenger for the financial obligations related to denied boarding. Again, the codeshare agreement may include a provision dealing with the compensation of the partner who has assumed financial obligations, whereas it did not make any overbooking.

Inter-Carrier Liability

Codeshare agreements (CAs) between air carriers are complex documents covering a wide range of issues that can arise in the context of code sharing, in particular the issue of liability for denied boarding. On this particular topic, CAs are generally structured in two parts.

- 1st part: vis-à-vis passengers

---

[65] Article 7 (1) (b) Regulation 261/2004: Unless the US airline refers to Regulation 261/2004 in its general conditions of contract; for more details on these references *see* Richard Ritorto et al., *Exploring Airline Contracts of Carriage and European Union Flight Delay Compensation Regulation 261 (EU 261) -A Bumpy But Navigable Ride*, 82 J. AIR L. & COM. 561, 574 (2017)

[66] *See supra* 3.2.2.

[67] *See* United Airlines, *Contract of Carriage Document 2021*, Rule 18 (A), (Feb. 2, 2021, 12:02 PM) https://www.united.com/ual/fr/fr/fly/contract-of-carriage.html. American carriers generally include the US denied boarding regulations for overbooking in their general terms and conditions or expressly refer to them.

In a first part, the parties start by setting out their respective obligations towards passengers and under what conditions. The CAs generally provide for a rule of principle that imposes on the actual carrier an obligation - almost automatic - to compensate the passenger in the event of a claim for denied boarding.

> "*In the event of denied boarding by the Operating Carrier […], the Operating Carrier shall (except to the extent such irregularity, involuntary rerouting or denied boarding is caused by the Marketing Carrier: […]at its own costs and expenses […] pay denied boarding compensation or otherwise compensate codeshare passengers […]".* (emphasis added).[68]

The CAs then determines the terms and conditions of carriage applicable to denied boarding passengers on code-shared flights. In principle, it is the marketing carrier's terms and conditions of carriage that apply to the marketing carrier passengers and vice versa.

> "*The Conditions of the Marketing Carrier shall govern the transportation of codeshare passengers"*. (emphasis added).[69]

As a consequence, in the event that a marketing carrier's passenger is denied boarding, the operating carrier shall compensate said

[68] Codeshare agreement between Great Lakes Aviation Ltd and United Air Lines, INC., September 2011, Section 7 (e), (Feb. 2, 2021, 12:02 PM) https://www.sec.gov/Archives/edgar/data/914397/000119312511279723/d247206dex102.htm. *See* also Codeshare agreement between Alaska Airlines, Inc. and Hawaiian Airlines, Inc., July 2001, Article 2.5. (Feb. 2, 2021, 12:02 PM) https://www.sec.gov/Archives/edgar/data/46205/000110465901503275/j2242_ex1d7.htm.

[69] *Id*. at Section 2 (c) and at Article 2.5.

passenger in accordance with the marketing carrier's terms and conditions. Should the conditions of the marketing carrier be more generous, the operating carrier has nevertheless the possibility to be reimbursed the difference in a second stage by the operating carrier. Indeed, CAs generally provide that, as between carriers, the conditions of the operating carrier are authoritative.

> "As between the Carriers, the Conditions of Carriage of *[the operating carrier]* shall govern the transportation *of Codeshare Passengers on Codeshare Flights*" (emphasis added).[70]

- 2nd part: between carriers

The second part deals with the liability of the parties to each other as a result of passenger claims. In this context, each of the parties undertakes to indemnify the other for passenger claims "caused by" its acts. These kind of provisions address the above-mentioned issue (*see* 4.2.2 and 4.2.3) *i.e.* that a carrier - actual or marketing - may have an obligation to compensate passengers for denied boarding, even though it did not overbooked the flight.

> "The *[Marketing Carrier/Operating carrier] shall indemnify, defend, protect, save and hold harmless [the Marketing Carrier/Operating carrier], from and against any and all liabilities […] provided that such liabilities, claims, judgments, damages or losses are caused by or arise out of (or are alleged to be caused by or arise out of) any alleged acts or omissions of [Marketing Carrier/Operating carrier] which are in any way related*

[70] *Id*. at Article 2.5.

to its obligations to be performed under this Agreement […]" (emphasis added).[71]

Synthesis

Regulation 261/2004 offers a clear solution for passengers since it designates the 'operating carrier' as the liable party in a code-share flight. However, when the flight is not covered said Regulation but by the US regulations, the passenger should refer to the general conditions of carriage, which can either designate the 'marketing carrier' as the liable party or the 'operating carrier' by reference to Regulation 261/2004. With regard to the complex issue of liability between the two carriers, it is usually the subject of specific provisions in the CAs. In this context, the central question of who "caused" the damage should be given special attention in order to mitigate the risk of interpretative issues between carriers. As the case may be, the contract may provide that any dispute on this point be settled by mean of arbitration.[72]

CONCLUSION

Denied boarding due to overbooking has decreased significantly in recent years, which is to be commended. Moreover, the legislation put in place by the US and the EU has the merit of offering a quick lump-sum compensation to passengers who are victims of overbooking. However, it is regrettable that the US legislation excludes (*i*) any compensation in case of overbooking for operational reasons - irrespective of the fact that the later may be solely caused by the carrier - and (*ii*) any right to care of the passenger.

---

71 *Id*. at Article 18.1.
72 *Id*. at Article 22.2.

With regard to the territorial scope of application of the two legislations, overlaps may occur, especially when a European carrier operates a flight between the US and Europe. This point should be clarified. The US and European legislations offer a first layer of swift and quasi-automatic protection to the passenger. However, this first layer may, in many cases, not be sufficient to cover all the damages suffered by the passenger. As a result, the passenger will have to start a long and costly legal procedure - the outcome of which remains uncertain - to assert all of his rights.

Finally, the US legislation does not expressly designate which carrier - marketing or operating - is legally liable towards the passenger in the context of a code-share flight. This gap could potentially create situations where both carriers pass the buck to each other, to the detriment of the passenger. In such a case, the passenger would be well advised to refer to the terms and conditions of carriage of the carrier with which he has contracted in order to know where to turn.

CARRYING '*RATNAS*' OF HEAVEN ON EARTH: A PRELUDE FOR SPACE MINING AND EXPLORATION PROGRAMME

Aditya Gatlewar

Introduction

The scientific-technological revolution has brought the new dimension into the transcending civilisation of humankind. Earlier, for the extraction of the minerals and other resources, we had to look down and dig the earth, no one would have ever thought of any other means. Today, science and technology have made it possible that in coming years we can look up into the sky and start digging. The science and technology has made the remarkable development that today we can extract metals, minerals and other resources from the celestial objects present in the space. The growing technology of 21st century desires these new resources; many high technology industries are now planning to advance their project and start using the extra-terrestrial resources like platinum group metals and the valuable water available on the moon. Since space has become the new gold rush, many advanced countries and business elites have started the big game of extraction of minerals from the space. However, due to its complexity and high-risk factor, strong laws and regulation are required to regulate the space mining programme. The idea of moving from limited earth resources to the infinite space has been tackled by many capitalists. However, as for the lawyers' such notion shall never be accepted because even though space is home to countless resources but at least for a certain period of development, there will always be the limitation to the technology and finances to expend on such heavy programme. This new opportunity shall be considered for the welfare of humanity and

human heritage. The wealth accrued from the space mining programmes shall not be limited to some powerful countries and elites but it should have the equitable proportion of opportunity to everyone. This thought has been emphasized in the various international instruments like UNCOPUOS and Moon Treaty. The extra-terrestrial resources shall be utilised with the principle of common heritage and for common humankind purpose, but it remains a difficult task to transpose this principle in the practical terms.

The idea of travelling and extracting resources from the extra-terrestrial region is not new to the Indians. Indian mythology provides various reference and stories where people can be seen exploring the space. For example, there is a story that '*Arjuna'* who leaves earth in the mortal form for the training purpose in heaven and come back. There is also a reference that 'Lord *Krishna'* went to heaven and brought '*parijaat'* tree (Night Jasmine) on earth and the most important is the episode of '*kshirsagar manthan'* or '*Samudra manthan'*(Churning of the ocean) from Hindu Mythology which inspires us for working together to extract '*Ratnas'* (minerals), which is discussed in detail in the latter part of the essay. The Mythology and the ancient text of Hinduism provide rich principles for the governance of various subjects of International Law and Relations including the Space Law. This essay is to explore such principles for space law and space mining programme but before that, we need to look at the current scenarios and challenges to space mining programme.

A Space Mining and Exploration Programme

The outbreak of 'Covid – 19 pandemic' has been tough and challenging for the development of the space sector. There are two

main reasons for this: the world has been facing the economic crisis to invest in the costly rocket launching activities and the second is the employees including engineers and technicians were not able to work in person, delaying the development of the space agencies. The pandemic has made the NASA to pause the production and testing of the mission's rocket which was meant for taking Americans to the moon again.[1] The downturn of the economy is now another reason to bring the extraterrestrial resources and to balance the loss. However, the recovery has been taking place amidst the pandemic, as the 'SpaceX' chief Elon Musk was kind enough to suggest the new Hobart-based boat builder which will help in the building of floating and super-heavy spaceports for travelling mars and moon.[2]

In the year 2018, Luxembourg has given the grant to private entities by bringing domestic laws to extract minerals from the space, it is a first European country and the second country in the world after the United States to give green light to private individuals to carry space mining and exploring activities, though the decision has been criticized by many International scholars as it goes against the idea of 'Global Commons' and they said that this decision will lead to more difficulty for bringing this principle of 'Global Commons' in practical terms. However, in some proportions giving the grant to private entities for space mining have overcome the loss of development happened due to pandemic situation. Therefore, the privatisation of the space sector can lead to the advancement of technology and speedy development in bringing the extra-terrestrial

---

1 Marina Koren, *The Pandemic Has Grounded Humankind*, The Atlantic, https://www.theatlantic.com/science/archive/2020/03/coronavirus-nasa-space-exploration/608782/ (last updated March 26, 2020).

2 Anna Moore, *why outer space matters in a post-pandemic world*, The Conversation, https://theconversation.com/why-outer-space-matters-in-a-post-pandemic-world-141977 (last updated on July 6, 2020).

minerals on the earth. However, the three main principles of the space law which were mostly developed in the times of cold-war shall be codified in the regulations of the space mining activities, though during that time, there were no any commercialized activities with space but still, the principles are of considerable importance for the development of space law. These three principles are summarised below.

Principle of Freedom of Exploration and Use

This principle is one of the most important principles which was developed in the early stage of space law and was the first practically accepted principle during the International Geophysical Year[3]. This principle became the key provisions of the outer space treaty which provides that the outer space including celestial objects and moon shall be free for exploration and use. The challenging issue is that the Outer Space Treaty is not clear on who can enjoy this freedom. The Article I Para 2 of the treaty states that:

"Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies."

The language in the treaty is not clear by what is the meaning of 'all states'. Does it mean that "all states who are signatory to the treaty" or all states irrespective of whether it is a signatory or not" or "all states including the entities that is NGO, Private Agencies etc."? The ambiguity in the language of the treaty is the biggest challenge to operate the space mining programme. The country of the United

[3] 1 VALERIE KAYSER, LAUNCHING SPACE ONJECTS: ISSUES OF LIABILITY AND FUTURE PROSPECTS 25 (1ed. 2001).

States and Luxembourg has given the grant to private entities to explore the mine but whether the treaty permits such freedom is not sure. Due to the ambiguity present in the treaty, private entities and individuals could not invoke any benefit from this principle. The 'right of adventure' is not present in the treaty for individuals may perhaps is the negative expression of the intention of the drafters.[4] However, the inclusion of such right is important for the private enterprises which act as an important potential contributor to the development and exploration of the celestial bodies.

Indian mythology also recognises the freedom of exploration, since the outer space can be considered metaphorically as new heaven, there are references of many *rishis* or Sages wandering around the earth as well as heaven or space. Most Famous is the '*Narad Muni'*, who is considered as the first Journalist in the world.[5] He kept wandering everywhere including the outer-space, taking whereabouts and exploring all the locations. '*Arjuna'* the third '*Pandava'* from the Mahabharata went to heaven or space for training and education purposes to learn the knowledge of war and state governance. There is another reference from the '*Bhagvata Purana'*, where Lord '*Krishna'* went to heaven and brought Night Jasmine (*Parijaat*) flower tree to fulfil his wife *Satyabhama's* request so that devotees can perform worship by taking the flower from the ground. The flowers fall in the night from tree hence called Night Jasmine, and as per the Hindu's, it is the only flower which can be collected from the ground and remains pious to perform worship to the gods. This gives us the idea that the resources from

---

4 Stephen Gorove, *Freedom of Exploration and Use in the Outer Space Treaty: A Textual Analysis and Interpretation*, 1 Denv. J. Int'l L. & Pol'y 93, 93 – 94 1971.

5 *Why Narad Muni is Known as Wandering Sage,* https://divine.onlineium.com/articles/why-narad-muni-is-known-as-wandering-sage.

the outer space can be brought on the earth, such idea has existed for a long time and therefore, the recognition of exploration and use of outer space for individuals is also important.

The principle of 'freedom of exploration and use' basically covers three rights, first is the right of free access, the second is right of free exploration and third is right of free use. The first right is to ascertain that all states have right to access the outer space, however, to tackle the difference between the 'exploration' and 'use' is a difficult task while interpreting the treaty, as in general 'exploration' can have the sense in respect of scientific meaning like fundamental research or exploration of planets and 'use' can be related with taking advantage of the outer space like satellites or other telecommunication equipment. However, the treaty remains ambiguous even if it is interpreted with the belief that only states can enjoy the freedom of exploration and use. The treaty needs to be further clarified with respect to the meaning of exploration and use. Since the development and space mining programme is all set to become reality, recognition of the private entities apart from states has also become important. The private entities need the recognition of the right to freedom of exploration to enhance the development and by doing this, the treaty will be clearer and it will eliminate the legal glitches present in the treaty with respect to space mining and exploration programme.

Principle of Non – Appropriation

This principle is important and is a norm of *jus cogens.* It guarantees that Outer Space is not a subject to national appropriation, meaning,

every state has the right to explore but states cannot claim any sovereignty or authority over any celestial bodies. The principle has been recognised in Article II of the Outer Space Treaty which states that

"Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means".

The original meaning of the principle of Non- Appropriation was understood in the broad terms, the principle was developed in the times of cold – war, the United States and USSR were two major space powers of the time and so to restrain any launch of a nuclear weapon in the outer-space, the principle of 'non – appropriation' was established. Both the forces would have been acquired lawful rights to claim the sovereignty and therefore, the Outer Space Treaty was drafted to forestall any appropriation in the space. However, with the time, the scope of Article II got indefinite. In the text of the treaty, no private entities or individuals are mention not because the intention of such exclusion has existed but because drafter did not speculate any such technological developments. The *travaux préparatoires* witnesses the letter to the chairman of the Committee on the peaceful Uses of Outer Space written by Arthur Goldberg, the permanent representative of the United States. He included two points that celestial objects should not be a subject of 'any claim of sovereignty' and later while incorporating the treaty, he said celestial bodies are "free for exploration for all states". Earlier, he used the term 'any sovereignty', does that mean that Goldberg had thought that sovereignty other than states can be taken on celestial bodies, but, for such interpretation, there is no tangible proof and

only the broad meaning can be considered that only the states are refrained from claiming any sovereignty over the celestial bodies.[6]

The Indian mythology also gives the lesson of non-appropriation; the idea of this can be learned from the event of '*Tripurantaka'* given in the *Shiva Purana,* the event is:

There was one *Asur* (or 'Demon') named *Taraka* who has three sons, *Taarakaaksha, kamalaaksha and vidyunmali.* The three together pleased the creator of the world – Lord '*Brahma'* and in happiness Lord '*Brahma'* grants them three aerial cities or planets revolving the sky and which are rich in iron, silver and gold. The planets were granted for thousand years for the living purpose, however, it made them very powerful, they started harassing the innocents on the earth. Many *rishis (Sages)* who objected to their abuse and dominance over the extra-terrestrial cities out of the planet earth were killed. Such the havoc they made on the earth. Many gods and other sages approached and pleaded to the 'Lord *Shiva'* (the destroyer) and said that demons are misusing the extra-terrestrial cities and powers which is damaging the whole civilisation of the humankind. Lord '*Shiva'* agreed to help, he created the powerful bow and arrow with components of all gods and goddesses like the chariot was the goddess earth herself and arrow was Lord '*Vishnu'* and destroyed the cities.[7]

The lesson of Indian mythology in the above-mentioned event is that no one can have absolute power over the celestial bodies. However,

---

[6] Abigail D. Pershing, *Interpreting the Outer Space Treaty's Non- Appropriation Principle: Customary International Law from 1967 to Today*, 44 YJIL 149, 154-155 (2019).

[7] Aravindan, *Why Shiva As Tripurantaka Must Act On 'Old Establishment' Demons This Karthik Purnima,* Swarajyamag (Nov. 12, 2009, 4:07 PM), https://swarajyamag.com/culture/why-shiva-as-tripurantaka-must-act-on-old-establishment-demons-this-karthik-purnima

some may argue the cities in the event do not reflect any celestial bodies. The mythology has to be interpreted as a metaphor. It doesn't matter whether the three cities in the above event are the celestial bodies or not. The lesson in the above event is that the grant given to the demons was only for living purpose implying the welfare of the humankind and not abusing it. However, the demons started abusing such grant and started misusing the planets of iron, silver and gold; such conduct shall never be accepted and needs to be immediately struck down. Indian mythology provides a rich principle for non-appropriation and establishes that resources of the outer space shall be used for the benefit of humanity and not misusing them with power and wealth.

The Principle of non-appropriation has been recognised which allow the ownership of space mining programmes and as per the Customary International Law, the principle prohibits individuals and private entities from owing any in situ property in the space. This can be explained through the case of *Nemitz V. United States.*[8] The brief fact goes as, NASA launched the robotic space probe named 'Near Earth Asteroid Rendezvous – Shoemaker' to study the asteroid named 'Eros'. Greg Nemitz, who considers himself as a space activist and owner of the 'Asteroid Eros' sent a notice to NASA for using his property for parking and storage. The General Counsel of NASA 'Edward Frankle' denied that Nemitz had any ownership over the asteroid as it would be in contravention with Article II of the outer space treaty. The matter was settled in the court with the presiding judge relying on similar reasoning in findings for NASA.[9]

---

8 *Nemitz v. United States*, ILDC 1986 (US 2004) (OUP reference), 1 (2004)

9 *Id. at 1-2.*

The case finds that in situ property in space is not accepted by the treaty. However, there have been many attempts to bring in situ outer space property. For example, the Bogota Declaration of 1976. It claimed sovereignty over in situ space property in the form of geostationary orbits. This attempt was however rejected internationally as it was considered against the principle of non-appropriation. The principle needs more advancement to conclude that individuals or private entities cannot claim ownership but are free to explore and use the celestial object which in no way should cause damage to the humankind.

Principle of Applicability of the International Law

Similar to the Law of the seas, there has been some discussion on whether the International law applies to the Space Sector or not. In the past, the freedom of use of high seas was established through the general consensus of the states and not through nature.[10] Similarly, the space law has been created with the consensus of the states and principles were set through outer space treaty which is the soul of space law. Some authors suggested that the International law principles cannot be applied to space sector because of the concept of '*cuis est solum eius est usque ad sidera'* meaning whoever owns the land has ownership up to the stars in the sky. The principle thus suggests that if 'A' owns the farm of 100 hectares, then the ownership remains consistent with parallel length drawn in the space or sky for 100 hectares. However, such a principle has long been abandoned due to its impracticality. Article III of the Outer Space Treaty recognises the acceptance of International law with Space Sector, it states that,

[10] Cestmir Cepleka & Jamie H. C. Gilmour, *The Application of General International Law In Outer Space*, 36 J. AIR L. &COM. 30, 30 (1970).

"States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding."

The Outer Space treaty accepts the principles of International Law including the Charter of the United Nations. The treaty also suggests that any action in the space sector shall maintain International Peace and Security and International co –operation. However, similar to the other principles, there is no involvement of non – state actors and private individuals. Eventually, with the entry of private entities, the making of space law for private individuals is of the utmost importance to avoid any space wars or space piracy. To cope with international peace and security, the Private International Space Law shall be recognised and codified in the subjects of International Law. There is no more doubt remaining that the private space industry is growing rapidly and therefore, the laws for private entities and commerce with the space mining and exploration programme is much needed. The reasons for this are summarised below:

1. The rich resources of space is the attraction of private capital, the thirst for business profits are increasing, there is a need for special recognition for 'Corporate Social Responsibility' for the welfare of the humanity from the profits arising out of space businesses.[11]

[11] Valentyn Halunko, *Private International Space Law. Philosophical and Legal Factors of Approval by the world community*, 22 Philosophical and Cosmology 16, 19 (2019).

2. With increasing private players in the space, the private companies are now the main actors of the outer space and extraction. Soon, there can be colonies with private ownership, such incidents can be hazardous to human being and may lead to persecution.[12]
3. The laws of extracting resources from outer space shall be ready before the beginning of such programmes on a regular scale. The laws beforehand will be beneficial for better governance.[13]
4. The laws for space mining and exploration programme should be adopted as international instruments of the United Nations along with the domestic legislation of each state. [14]

The Space Mining and Exploration programme will be chaotic if states do not recognise the fundamentals of the Space Law. It is the responsibility of the states to bring the principles in the domestic legislation and avoid any chaos among the private players as well among the states. The ancient Hindu scriptures give us the idea of '*Desha Dharma'* which can be translated as' 'State responsibility'. The concept of '*Desha Dharma'* from the text of '*Manusmriti'* and '*Arthashstra'* implies that the inter-state relationship shall be on basis of common humanity.[15] The Hindu Scriptures in its essence of '*Dharma'"* (Duties) conveys to us that the states have to work together in such a way that the fortune of space will benefit the common humankind. The developed states have to help the countries who are still in transition with the economy. The Hindu

---

12 *Id.*
13 *Id.*
14 *Id.*
15 Pramathanath Bandyopahya, International Law and Custom in Ancient India, 18 (1920).

Scripture of '*Shatapata Brahman'* elaborates that the '*Dharma'* or duties are to protect and support the weak. This is explained through the event of '*Matsya'* avatar of the 'Lord Vishnu'. The event is that, once the king named Manu came across the fish asking for the protection from the bigger fish. Manu protects it and keeps it in the pot. Later, the fish started to grow, he kept it in a pond, later in the lake, then in the sea, and finally, the flood comes, fish asks Manu to gather your family along with '*Saptarishis'* and the fish has taken all of them to top of the mountain '*Meru'* to save them from drowning. Fish later reveals that it was Lord '*Vishnu'* himself who came in the fish form to give the message for the humankind survival.[16] The message was 'to sustain the human civilisation, one has to disdain the law of the fish. In the fish world, small fish is eaten by the bigger fish which is called '*Matsya Nyaya'*. The '*Dharma'* according to the '*Shatapata Brahman'* is to disdain the law of the fish and protect the weak for survival. The Hindu Mythology gives a very significant message that the advanced states which are going to accrue the wealth with their advanced technology shall protect and support those states that are still vulnerable to hunger, poverty, diseases and all other basic human needs. Such legislations for the space sector shall be adopted for both states as well as individual in a way which can contribute to the elimination of poverty and can contribute to the good governance of underdeveloped states. However, bringing such thoughts in practical terms is not a delighting task, therefore everyone has to be considered for working together for the extraction programme, this is explained through the event discussed below. Thus, International Law applies to the space sectors but needs many more advancements and Indian Mythology

[16] Klaus K. Klostermaier, A Survey of Hinduism 97 (3d ed. 1933).

can play a vital role in the advancement of the humanities with respect to International Space Law.

'*Kshirsagar Manthan'*- An Event of Inspiration for Working Together

'Kshirsagar Manthan' is one of the prominent events in the Hindu scriptures; it means 'churning of the ocean of milk'. This event is of considerable importance and gives the important lesson that, we need to work together to obtain any sort of minerals or success. The event goes as,

Once, '*Indra'* King of gods was encountered with the Sage '*Durvasa.'* He offered a garland to the *Indra. Indra,* because of his ego, he gave the garland to his mount 'elephant', due to the presence of the odour of flowers in a garland, the elephant got allergic and threw it away. This made sage '*Durvasa'* angry and cursed him that he and all other gods (*Devas)* will lose all the powers.[17] '*Asuras'* took the opportunity and defeated the gods (*Devas)* and took over heaven. All the gods approached 'Lord *Brahma'* and he sent them to Lord '*Vishnu'*. Lord '*Vishnu'* asks them to make peace with '*Asuras'* by exchanging something valuable. Lord '*Vishnu'* directed them to churn the '*Kshirsagar'* (ocean of the milk) by working together and so to provide the balance, Lord '*Vishnu'* took the form of tortoise on which Mountain '*Mandaar'* was placed and *Vasuki* (Snake) acted as a rope. The '*Devas'* and '*Asuras'* started the process where they have to 'push and pull' that is when '*Devas'* will pull the tail part of the snake, the '*Asuras* 'will push the head part of the snake and vice –versa making the ocean churning. By churning

[17] Drishith, *Samudra Mathan –Everything you need to know,* Vedicfeed, (July 1, 2020), https://vedicfeed.com/samudra-manthan-everything-to-know/.

the ocean of milk, many minerals have emerged. These are listed below:

1. *Ratnas,* 14 valuable gemstones have been emerged by the churning which was divided between '*Asuras'* and '*Devas'*. The Outer space is home to valuable minerals, the essence of such minerals shall reach everyone irrespective of the degree of economy of the state.

2. Goddess '*Lakshmi'*, Lakshmi is represented as the Prosperity in the Indian Culture and Households. This symbolises that by working together, prosperity is achieved.

3. *'Chandra',* it is believed that the moon has emerged from the churning, this personifies that to reach the valuables of the moon, one has to work together. The United States is the first country to step on the moon. This has resulted amidst the cold war between the US and USSR. However, Indian mythology gives inspiration for working together and not engaging in the tug of war, if this principle was being implemented, the technological development today has been much ahead.

4. Lord '*Dhanvanatari',* he is considered as the god of health. When he emerged from the churning, he carried '*Amrit'* that is immortality nectar with himself for which the churning has been made. Lord '*Dhanvantari'* is considered to be the god of medicines. '*Devatas'* took the immortality nectar and '*Asuras'* were guided by '*shukracharya',* a renowned sage for the medicines. Thus even the medicinal properties were distributed evenly. This gives us the message that any medicinal development taking place from the resources of the outer space shall be given to everyone. For example, the meteorite present

in the outer space is consisting of medicinal properties for treating diseases like anaemia, melancholia etc. [18]such medicines shall be given to those states that are still in transition with the economy and cannot afford medicinal treatments.

While churning took place, the poison has emerged from the snake vomiting, this poison was polluting the ocean and killing the aquatic life. 'Lord *Shiva'* had drunk all the poison and saved the aquatic life. This gives us the message that any programme for extracting minerals from nature will produce some kind of pollution but we forget to take any liability for it. Indian Mythology not only provides the fundamentals of extraction of minerals from nature but also remind us to take the liability and take precautionary and preventive measures to save the environment.

How to Tool the Abstract

The Privatisation of the Space Mining and Exploration programme is beneficial to advance the development. But this can create chaos, as business players without any effective laws will dominate the space programme and will accrue all the wealth and the essence of it will not reach to resolve the humanitarian crisis. The Indian Mythology can inspire the International fraternity including the MNCs and other entities to work together for humanity and human heritage. To implement these thoughts, Indian Mythology gives the following lessons.

1. Freedom of 'Exploration and Use' shall be given to every individual and this freedom shall be utilised in such a way that

[18] *Meteorite,* RavenCrystals, (Sept. 1, 2018), https://www.ravencrystals.com/METEORITE_df_1136.html#:~:text=HEALING%3A%20In%20healing%2C%20Meteorite%20may,becomes%20one%20with%20the%20spirit.

it will benefit humanity. Lord Krishna is an inspiration as he brought the Night Jasmine tree for human welfare.

2. Principle of 'Non – appropriation' shall be established in a very effective way. The event of '*Tripurntaka'* gives us the lesson that misuse and abuse of power and wealth accrued from the Outer – Space shall be immediately struck down.
3. The International Law applies to the Space sector. The ancient idea of '*Dharma'* and '*Deshadharma'* shall be implemented in the International Space Law.
4. The event of '*kshirsagar manthan'* inspires us that, any state shall not be kept isolated from the extraction programme, similar to the 'push and pull' given in the event, all interested states shall be allowed to contribute to the programme and shall be given the equitable share from the minerals obtained from the space.
5. To successfully extract the minerals from the space one has to work together like the '*Devas'* and '*Asuras'* and in the case of any dispute, Culture of Mediation shall be promoted. The space sector is complex and has a high-risk factor, therefore, the win-win situation is important and equitable distribution of '*Ratnas'* or minerals shall take place as explained in the event of '*Kshirsagar Manthan'.*
6. The poison emerged out from churning in the event of '*kshirsagar Manthan'* symbolises that any extraction process will lead to the pollution of the environment, the great Lord '*Shiva'* consumed all the poison so that environment does not get damaged. This is an important lesson for humans to take the liability of the environment in the extraction process.

Conclusion

The current space law is not clear with respect to space mining and exploration programme. In any coming year, we can witness the companies using the space resources for technology for various types of equipment including cell phones, automobiles etc. The silence and ambiguity in the Outer Space treaty are hazardous to the Space sector. Space law must be developed with special attention to human welfare. As this essay argues that, the idea of travelling and exploring space is not new. The ancient scriptures of Hinduism witnessed such events. Along, with Hinduism, the mythological stories and literature of many religions such as Greeks and Romans are also well- equipped with the idea of space, moon and other celestial bodies. Humans have been studying the space and cosmology for more than thousands of years. The outer-space has become one of the prominent parts of their life. Therefore, the essence of it shall reach every human being or every state irrespective of their degree of economy and technology. The Indian Mythology gives the motivation for the extraction of minerals from the space but at the same place, it also reminds how we have to treat the resources and save the environment from the poison of extraction.

PRIVATE SPACE ENTITIES COUNTING STARS AND LIABILITIES

Deeksha Anand & Anchit Baliyan

INTRODUCTION

It was a hot Tuesday evening when the founders of Swan Airlines, Natasha and Rohit, came to know about India's first step towards Space Tourism, the release of the launch date of Gaganyaan. Later when they got to know that Richard Branson, their role model, was setting up Virgin Galactic's office in New Delhi with the aim to explore this newly set up industry, both of them were hit with a tremendous flare of motivation and step into this arena themselves. However, their calculating nature forced them to get thoroughly acquainted with Indian Legal Provisions and the states' liabilities under international organizations and conventions.

Like the founders of any other company, Natasha and Rohit's primary concern was the cost of operations by expanding into this arena. While demarcating heads under Costs, they found themselves deliberating on the liability costs which the private entities would have to bear if any mishap or accident occurred. Liability, they noticed, could potentially arise against both the passengers and the carrier. Their lack of legal acumen turned them to their legal team, seeking advice regarding India's approach towards Carrier and Passenger Liability in the field of Space Tourism and the international approach in general. They called on their legal department, to draft a collated legal opinion discussing the Potential Hurdles a new player would be faced with, whilst trying to participate in the Space Travel Industry and further sketch out few recommendations in this regard to both the Government and the Private Entity.

Through this article, the legal team of Swan Airlines that consists of both the authors would delve into the legal scenario of liability existing in Space Tourism and would give some solutions to tackle the existing situation.

Before addressing the position of liability, it is imperative to start with the basics and first answer the question 'What is Space Tourism?' The traditional dictionary definition would have, 'Space Tourism' be defined as any commercial activity offering customers direct or indirect experience with space travel[1] and a 'space tourist' as someone who tours or travels into, to, or through space or to a celestial body for pleasure and/or recreation.[2] This kind of tourism has developed essentially in three stages. In the first stage, the entities involved were very limited. Only a few public bodies undertook launching and operating space objects. The role of Private organizations was limited to manufacturing and other related services. In the second stage, the private entities wanted to realize the profits of this new industry and thus, they also started undertaking the launch of space objects. In order to control these entities, the states started developing their national laws to include the obligations towards these entities. Finally, in the third stage, there was introduction of manned spaceflight and complete privatization of this industry.[3] The pace with which private entities started entering into this arena was way ahead than the pace with which states and countries developed and amended their laws to address the issues that might arise with such privatization.

---

1 Stephan Hobe & Jürgen Cloppenburg, *Towards a New Aerospace Convention? Selected Legal Issues of Space Tourism,* 47 I.I.S.L. (2004).

2 Zeldine Niamh O'Brien, *Liability for Injury, Loss or Damage to the Space Tourist*, 47 I.I.S.L. (2004).

3 Frans G. Von der Dunk, *Space Tourism, Private Spaceflight and the Law: Key Aspects*, SPACE, CYBER, AND TELECOMMUNICATIONS LAW PROGRAM FACULTY PUBLICATIONS, 2011, 60 available at https://core.ac.uk/download/pdf/188081929.pdf.

PRIVATE PLAYERS AND THEIR ASPIRATIONS

Humanities' attempt to push and explore the boundaries of space has always been under the strict supervision and autonomy of National Governments. While these routine regulations have allowed the space expedition campaigns to be careful, meticulous and wary of rushing into decisions which could cost lives, this babysitting effort is not really required anymore as we step into a different technological age. We speak of an age where private entities with substantial capital have joined the space race. They promise to make the dreaded space tour, an accessible and convenient mode of travelling and recreation.

Elon Musk's SpaceX has emerged as a leader in controlled Orbital Space flights. NASA's collaboration with SpaceX to carry commodities, space objects, etc. to the International Space Station[4] is but a positive sign of Government's intention to outsource the relatively humble tasks to Private players so that it could focus its limited and constrained resources and time on research, and concentrate on collating efforts to further penetrate into Humanities' understanding of outer space. The manned Orbital Flight of SpaceX CREW-1 was hailed by all private space organizations around the globe as a major step in the right direction by Governments.[5]

Another promising Private entity with significantly visible efforts to get man off the ground and flown all the way to outer space is Sir Richard Branson's Virgin Galactic. Virgin Galactic in close coordination with the spaceship company is developing and

---

4 Dragon, SpaceX, https://www.spacex.com/vehicles/dragon/ (last visited Jan. 10, 2021).

5 Leadership, SpaceX, http://www.spacex.com/about/leadership (last visited Oct. 12, 2013).

operating a new generation of space vehicles.[6] Not just that, Amazon founder Jeff Bezos's Space Company Blue Origin is all set to take the first woman to the moon's surface.[7]

THE LIABILITY ISSUE

Of all the modes of travel that coexist with each other today, Space travel is perhaps not only the most convoluted mode of carriage but an arena of technological advancements that has attracted the most brilliant minds to dispense their dexterity, ever since its dawn. The extreme volatile nature of the affairs surrounding Space Travel is such that it has claimed the lives of 18 people. The overview on this statistic is that 3.2% of Spacemen have lost their lives while in space or in preparation for a space operation.[8] Taking into account, the innumerable risks involved, this figure is surprisingly low and yet high enough to scare the space organizations whilst calculating the potential economic liability.

When one thinks about the liability regime, the Outer Space Treaty[9] and the Liability Convention[10] is the first to come to mind. In the initial days of the quest of mankind to explore space, a number of principles of international law were introduced. These were the 'common interest', 'freedom' and 'non-appropriation' principles.

---

6 *Virgin Galactic Takes Ownership of Spaceship Co.*, L.A. BIZ (Oct. 8, 2012, 12:53 PM), http://www.bizjournals.com/losangeles/news/2012/10/08/virgin-galactic-takes-ownership-of.html.

7 Diane Craft, *Bezos says Blue Origin will take the first woman to moon's surface*, THE HINDU (Dec. 6, 2020, 11:56PM), https://www.thehindu.com/sci-tech/bezos-says-blue-origin-will-take-the-first-woman-to-moons-surface/article33262587.ece#:~:text=Jeff%20Bezos'%20space%20company%20Blue,to%20the%20moon%20by%202024.

8 *Human Beings In Space: Debate And Consequences*, BRITANNICA (Feb. 10, 2021), https://www.britannica.com/science/space-exploration/Human-beings-in-space-debate-and-consequences.

9 The Outer Space Treaty 1967.

10 The Convention on International Liability for Damage Caused by Space Objects 1972.

These were then codified by being included in Article I and II of the Outer Space Treaty. There was a general acceptance among states all over the world that Outer Space could be regarded as *res communis omnium*.[11] Giving such regard to Outer Space means that now it is considered 'free' for use for all kinds of activities including tourism. Majority of countries, including India, are a part of both these conventions. However, this liability system does not include space tourism and only talks about individual states sending personnel to space for research and development purposes. There is neither any mention of private people nor liabilities of private entities.

INDIAN SCENARIO

At present, the 2 statutes pertaining to the regulation of space operations that the Indian Government has in its pipelines, i) Space Activities Bill, 2017[12] and, ii) Draft Space based Communications Policy, 2020[13], place heavy liabilities on Private Players participating in the development of the Indian Space regime.

Apart from that, the Space Commission (SC) has been entrusted with the work to formulate policies and guidelines for space related activities. In the international regime, India is a party to the Outer Space Treaty of 1967, The Rescue Agreement of 1968, The Liability

---

11 ANTONIO CASSESE, INTERNATIONAL LAW, 156 (2nd ed., Oxford University Press, 2005).

12 Nitin Sarin, Vinamra Longani and Dhawal Jain, *The Space Law Review: India*, THE LAW REVIEWS (Dec. 17,2020), https://thelawreviews.co.uk/title/the-space-law-review/india.

13 *Pvt sector space players are liable for damages to space objects in space: Draft Spacecom Policy*, ECONOMIC TIMES (Oct. 20,2020, 2:12PM), https://economictimes.indiatimes.com/news/science/pvt-sector-space-players-are-liable-for-damages-to-space-objects-in-space-draft-spacecom-policy/articleshow/78805726.cms?from=mdr

Convention of 1972, The Registration Convention of 1975 and The Moon Treaty of 1979.[14]

It becomes immensely important to understand that formally opening the space-market to private players will not be enough to thrust the industry off the ground. As the launchers and the ones getting launched are gearing up to explore this newly found industry, it becomes imperative for India to identify the issues which could arise and then amend or introduce new legislations to tackle them.

CARRIER LIABILITY

Prima Facie problem for Private Space entities

It has become clearly evident now that numerous Private Corporations are not just fascinated by the idea of joining the space race but have also exhibited their ability in doing so. This however, will naturally certainly shoot up the risks and plausible accidents resulting in the unfortunate death of some spacemen. The kin of the aggrieved parties would most certainly seek for a hefty compensation from not just the Private Entity responsible for transporting the passengers but also from the Spacecraft Part Manufacturers. In such a situation, a Court is most likely to pick a principle of law from an old existent statute or doctrine and apply it to a very new Arena.[15] Holding Private space entities similar to the jobs of other common carriers in the field of transportation and ascertaining what duty of care the Private entity must satisfy, is something that is dreaded by Space Travel commentators and

---

[14] Anubhav Pandey*, India's role in International Space Law*, I-PLEADERS (Jun. 19, 2017), https://blog.ipleaders.in/space-law-india/.

[15] Justin Silver, *Houstan We Have a (Liability) Problem*, 112 MICHIGAN L.REV. 833 (2014).

activists. The end result could be massive liability for a still nascent industry.

With such prominent threats to the young Private Space Entity Industry, there is no iota of doubt left in the minds of said entrepreneurs that the industry could fall apart and perish without finding steady footing. Without any help from the government, even if these entities escape the umbrella of Common Carriers, they will certainly not flourish and lose their incentive to do business with massive liabilities risks facing them regularly. The escalating costs of tort litigation, Part Manufacturer Liabilities clubbed with near impossibility to find insurance, the risks do not stop coming. The only suitable solution to this problem is the government enacting concrete legislation which limit liabilities for these entities, subjected to certain conditions.

Common Carrier Liability and the need for Space Travel Industry to escape it

Carrier services, such as tour buses, railways and airlines, provide their services to the public under the supervision of a regulatory authority, which lays down the measures of safety that compulsorily have to be complied with. For eg. What DGCA is to Aviation. What needs notice in the definitions of carriers and common carriers, is the need of the space travel industry to escape the status of Common Carriers. The Carriers, Act 1865, defines a common carrier as any individual, firm or company (other than the government, who or which transports goods as a business, for money, from place to place, over land or inland waterways, for all persons (consignors) without any discrimination between them.[16] A person who carries

[16] The Carriers Act, 1865 §2.

goods occasionally or free of charge shall not be called a common carrier.

The issue with Common Carriers is the heightened quantum of liability, roughly around 1 crore Rupees per each passenger, which has been sketched out in the first schedule of Carriage by Air Act 1972.[17] A Private Carrier on the other hand may enter into a contract with someone to carry goods or people on the terms agreed upon between them. In such a situation, it is a contract of bailment. Therefore, such transactions are not covered by the Common Carriers Act, 1865. The liabilities of a private carrier are less regulated by the government and would thereby, flexibly mould itself on a case-to-case basis. The following explores how designation as a common carrier may affect manned space flight entities by irreversibly harming the industry:

1. Hefty Costs of Liability

Albeit the space industry is still majorly supported by capital surplus ventures such as *Virgin Galactic, SpaceX, and Bigelow Aerospace and Blue Origin,* the potentially large and devastating tort costs which are only rapidly increasing with the growing GDP of USA and India[18], could scare off the individuals behind these Business Groups, who are willing to risk personal fortunes at risk to design and develop space tourism. It will not be fair to compare the expansion of pioneering industries like railways and aviation, since the potential risk liabilities of tort costs in Space travel will be multiple fold more than the other industries. Owing to the *naivety* and unpredictability of the industry, it will become tremendously

[17] The Carriage by Air Act, 1972 §22.

[18] Russ Sutter, *Update on U.S. Tort Cost Trends*, https://www.casact.org/library/studynotes/Towers-Watson-Tort-Cost-Trends.pdf (Last visited Feb. 1, 2021).

more difficult to sketch a way out, avoiding tort costs and at the same time preserving the quality of their work, than it took for other travel industries.

The Private Space Entity Industry is challenged by an incredibly different legal position than the other travel industries who were carrying hundreds of passengers.[19] Even at a highly developed and mature stage of the Space Travel Industry it practically cannot have more than handful of passengers aboard their vehicles. The purpose of transportation for future Space Travel Participants won't just stick to the definition of the word but also for Adventure and collecting new and unique experiences. There has been a plethora of cases where a court of law has found that transportation involved in an adventure sport should merely be considered incidental to the actual service of the adventure sport facility.[20] These Adventure Sport facilities conveniently escape the umbrella of Common Carriers, thereby, avoiding the huge tort costs that come clubbed with it. The railway and aviation industry have enriched the world with a neat industrialised system of getting huge chunks of people to and from places. The space industry will have expanded enough to face the exposure of bulk liabilities after it has set concrete footing in the market, much like Railways and Aviation did.

2. *Lack of Insurance Options*

Another problem is the intense struggle to look for suitable insurance which could cover the seemingly huge sums of tort liabilities at a reasonable cost. While the federal government of

[19] R.W. KOSTAL, LAW AND ENGLISH RAILWAY CAPITALISM 1825–1875 293 (Oxford University Press 1994).

[20] Jones v. Dressel, 623 P. 2d 370, 377 (Colo. 1981); Malecha v. St. Croix Valley Skydiving Club, Inc., 392 N.W.2d 727, 731 (Minn. Ct. App. 1986).

United States offers insurance to cover launches and operational satellites in orbit[21], the Indian Government has no such policy in place.

Neither US nor India, however, have any insurance companies handing out covers for space flight entities. It is very uncertain, whether the insurance companies will put up a policy to cover Private Space Flight Entities against liabilities from passengers. Space flight Enthusiasts and stakeholders have suggested that the insurance industry will be put in a spot of bother for having to adequately cover the space industry because it "is so new that insurers and underwriters know little about the potential risks and liabilities associated with the activity.[22]

The risk of a court holding that a manned space flight operator is a common carrier drives up the liability risk for the industry tremendously and could cause the industry to crumble prematurely, particularly because the specific hazards that passengers face are often unknown.[23]

3. *Liabilities consuming Part Manufacturers*

The risk of product liability for Spacecraft Part Manufacturers is an additional problem that may cause hurdles in the swift development of Space Travel.[24] If we look at the business of Spacecraft Part Manufacturers in close consonance with what Aircraft Part

---

[21] Pamela L. Meredith, *Space Insurance Law—With a Special Focus on Satellite Launch and In-Orbit Policies*, 21 AIR & SPACE LAWYER 4, 13 (2008); 51 U.S.C.A. § 50914(a)–(c) (West 2013).

[22] Paul Ordyna, *Insuring Human Space Flight: An Underwriter's Dilemma*, 36 J. Space L. 231, 251 (2010).

[23] Justin Silver, *Houstan We Have a (Liability) Problem*, 112 MICHIGAN L.REV. 833 (2014).

[24] Michael C. Mineiro, *Assessing the Risks: Tort Liability and Risk Management in the Event of a Commercial Human Space Flight Vehicle Accident*, 74 J. Air L. & Com. 371, 397–98 (2009).

manufacturers do, we'll find that the Manufacturer of an Aircraft may be at fault in several different ways, however, for him to be liable, the craft must have a design defect or manufacturing defect. This can include: The Manufacturer's failure to warn or inadequate warnings about known issues, or incorrect emergency instructions, as well as incorrectly manufactured or assembled parts or the inability of parts to respond as expected.[25]

Even if they ascertain all the mentioned things, the litigation costs with claims being raised by the aggrieved parties could practically bankrupt a manufacturer, that produces small parts for Space-crafts, since they are not in the class of other cash rich Private entities.

Close to Six states in the US today, offer a tort liability immunity to Private Space Entities.[26] This includes placing caps on liability, Insurance Options, etc. The statutes, which these states have enacted though do not extend any immunity to manufacturers or service providers. This can result in the Private players getting demotivated and quitting the industry once and for all, since there is a massively looming possibility of the manufacturers shouldering the entirety of liabilities. The ruthless effect of this absence in immunity can also be observed in the aviation industry from 1970s to 1990s.[27]

Comparative Analysis between Indian and US space policies

The draft of Space Activities Bill 2017 and Space Based Communications Bill 2020, has shed substantial light on the

---

[25] Dr. Shaik Nazim Ahmed Shafi, *Aviation Liability: An Overview*, http://nalsarpro.org/Portals/23/Courses/MA%20-%20ALATM/SEM%20II-PPTS-2018-19/Day5-3.%20AVIATION%20LIABILITY.pdf (Last visited Feb. 5, 2021).

[26] Cal. Civ. Code § 2210(d) (West Supp. 2013); Va. Code Ann. § 8.01-227.8 to .10 (2007 & Supp. 2013).

[27] Justin Silver, Houstan We Have a (Liability) Problem, 112 MICHIGAN L.REV. 833 (2014).

problem that challenges private players. Section 12(1) under Chapter 4 requires the Private Entities to indemnify the Government for all the claims brought against it.[28] This implies that the government will bear no responsibility or liability in case of a mishappening and the entirety of it will be borne by the Nascent Private players. The provisions stipulate that the Central Government shall also determine the quantum of liability to be imposed upon the licensee, i.e., the private space entity.

Section 16 of the proposed bill lays down the Punishment for causing damage or pollution to environment.[29] The provision does not have any levee for unintentional acts done to cause damage or pollute the environment. It appears from the language of the bare text that the levy of fine will not take into account the intension of the party in doing said act. There can be numerous plausible scenarios where an infant private entity can unintentionally cause diminutive damage to the environment, but won't be able to escape the heavy fine of 1 Crore rupees.[30]

The United States' CSLAA has an upper hand over the Indian draft of space activities bill for it attempts to secure private players from risks of liabilities. The similarity between both legislations is that the government will operate on the same Licensing Model. The CSLAA, however, prohibits any Governmental Agency from issuing any regulations[31] which affect the design or operation of a launch vehicle which provides a sense of independence to private entities in their carrying of business.

STATUS OF A SPACE TOURIST AND PASSENGER LIABILITY

[28] The Space Activities Bill, 2017 § 12(1).
[29] The Space Activities Bill, 2017 §16.
[30] The Space Activities Bill, 2017 §16.
[31] 51 U.S.C.A. § 50905(c).

The current legal regime is not soundly set up to deal with liability issues arising in Space Tourism, especially in the case of Space Tourists. In fact, the current system only covers state efforts or efforts by international non-governmental organizations which send astronauts and other equipment into space for scientific research and exploration. This issue intensifies further in case of a private spaceflight wherein the flights are launched not by any governmental launch facility or a state's territory.

The Outer Space Treaty mentions 'astronauts' to be 'envoys of mankind' and puts an obligation on states to render assistance to them in case of an accident, distress or an emergency landing.[32] The Rescue Agreement, on the other hand, broadens the scope by using the term 'Personnel of a Spacecraft' instead of 'Astronauts' and defines the obligation of states towards them. The former term includes space engineers and scientists along with astronauts. Considering the broad nature of the Rescue Agreement and it being 'prompted by sentiments of humanity', space tourists can be interpreted to be included under 'Personnel of a Spacecraft'.[33]

In order to understand this extended application of the Rescue Agreement, reliance can be placed on the CSLAA and the ISS IGA. The CSLAA defines 'crew' and 'space flight participants' and includes these terms along with the existing payloads. There was an attempt to cover Space Tourists under 'spaceflight participants', however, this did not resolve the protection issue w.r.t. these

---

[32] The Outer Space Treaty art. 5, 1967.

[33] Fred Kosmo, *The Commercialization of Space: A Regulatory Scheme that Promotes Commercial Ventures and International Responsibility*, 61 S. CAL. L. REV. 1055, 1070-71 (1988).

tourists.[34] Attempting to provide a broader approach, the ISS IGA, as does the Rescue Convention, covers the activities of all individuals involved in outer space activities under the heading 'Protected Space Operations.'[35] This means that even a passenger for fun will be covered in ISS IGA.

The problem, however, arises when one considers the SpaceShipOne Model. This model compels one to distinguish the space vehicle attached to the aircraft until their separation. After this separation, the space vehicle becomes a space object depending on the mission because of which it was launched.[36] According to the air law, space tourists would obviously fall within the realms of passengers and thus, they are to be considered under the aircraft commander. In contrast to this, transportation by a space object in place of a vehicle gives birth to the most important question i.e. whether these passengers are to be granted the same status as that of an astronaut or whether they must stay in the realms of passenger.

The Outer Space Treaty is found to have thrown a lot of light on the obligation of states towards astronauts under Article V.[37] The Rescue Agreement puts a similar obligation on states in case of 'personnel of aircrafts'. These three terms, as has been observed, bear different connotations. 'Astronaut' bears an explorative meaning; 'envoy of mankind' seems to be attached to a more humane meaning and finally, 'personnel of aircraft' seems to be more functional in nature.[38]

---

[34] *Recent Development: Commercialization of Space Commercial Space Launch Amendments Act of 2004*, 17 HARV. J.L. & TECH. 616, 626 (2004).

[35] ISS IGA art. 16(2)(f).

[36] Stephan Hobe, *Legal Aspects of Space Tourism*, 86 NEB. L. REV. 439 (2007).

[37] The Outer Space Treaty art 5, 1967.

[38] Ram Jakhu & Raja Bhattacharya, *Legal Aspects of Space Tourism*, 45 PROC. COLLOQ. L. OUTER SPACE, 112, 119 (2002).

Theoretically, space tourists should be regarded as 'Personnel' and the state of registration should be allowed to exercise control in terms of safety and liability on such tourists. Further, if these personnel, were to visit another state of registry and a mishap occurred, the jurisdiction would said to lie under the state of registration where the mishap happened. However, practically this assumption will fail as it has been opined that only certain people, performing specific functions w.r.t. the space vehicles can be included under the definition of 'personnel'.[39] Apart from the legal scenario, the willingness of states also needs to be considered. Majority of the states would not be willing to protect or grant immunities to personnel who are not contributing anything to their country or who are not participating in any space missions. The nature of the visit of these tourists is very different from the ones taken by astronauts and thus, it has been observed that the applicability of the Rescue Agreement or the Outer Space Treaty which was drafted keeping in the mind the image of astronauts, on these tourists might be irrational.[40]

Another important convention dealing with outer space laws is the Liability Convention. Article VII of the Convention states that ''the Liability Convention does not apply to damage caused by a space object of a launching state to nationals of that same state and to foreign nationals during such time as they are participating in the operation of that space object." [41] This makes it clear that this convention does not apply or obliges the states towards passengers,

---

[39] Stephan Gorove, *Interpreting Salient Provisions of the Agreement on the Rescue of Astronauts, and Return of Objects Launched in Outer Space*, 11 PROC. COLLOQ. L. OUTER SPACE, 93, 93 (1968).

[40] Lesley Jane Smith & Kay-Uwe Horl, *Legal Parameters of Space Tourism*, 46 PROC. COLLOQ. L. OUTER SPACE , 37, 41 (2003).

[41] The Liability Convention art. 7.

whether national or international of the launching state participating in the operation of its space object. Set against this, is a very essential argument which entails that this convention can be said to be applicable to space tourists. This is because these tourists take trips to the space for pleasure and not for participating in the operation of the space object. By undertaking these space missions and tours, the passengers make themselves voluntarily vulnerable to risks. Against this background, holding the launching states absolutely liable for these damages would be inappropriate.

At present, the Liability Convention lays down that only the launching state has an absolute liability in case of a mishap or accident. However, emerging space tourism makes it imperative to amend the rules and regulations in such a way that passenger liability is included in it. The two-tier liability system of the Convention for the Unification of Certain Rules for International Carriage by Air ("Montreal Convention") talks about passenger liability. Article XVII and Article XXI of the Convention state that on the instance of any injury or death of a passenger, the liability of the carrier is unlimited.[42] Further, according to Article VII, the international liability for any damage incurred by a space object is imposed on the launching State, regardless of the space object being a public or a private entity.[43] A bare reading of these provisions clearly show that they do not pay heed or talk about the liability of private organizations, rather they only cover states.

RECOMMENDATIONS AND SOLUTIONS

The authors have highlighted the position of Private Space Entity facing a web of heavy liabilities and have sketched out many major

[42] Convention for the Unification of Certain Rules for International Carriage by Air, 1999.
[43] The Montreal Convention art 7, 1999.

issues that go with rising liabilities against players of a travel industry that is at an embryonic stage. Neither the Space Activity Bill, nor any treaties that India is a signatory to, effectively deal with the gaping problems of such Private Entities. The absence of any rigid legislation in this regard will, certainly, be portrayed as a cause for the lapse of an industry. Apart from the obvious and immediate need to establish a uniform legal system for Space Travel, the authors recommend the following reforms*:*

1. *Liability Caps for Private Space Entities*

This solution is one of the more comprehensive approaches at providing steady footing to the industry. It becomes important to observe here that each state derives its liabilities, arising in case of a space accident, from The Liability Convention 1972[44] and The Outer Space Treaty, 1966.*[45]* The Space Activities Bill allows the government to completely indemnify itself from the liabilities, making the Private Space Entity bear the heavy burden of High Tort Risk Liabilities and furthermore, allows it to decide on the quantum of liabilities.[46] A handful of jurisdictions have legislated certain statutory provisions which attempt to shield Private Space Entities from the risk of liabilities by placing a relatively friendly cap on the quantum of liabilities. These include United States' CSLAA, 2004[47] and the Warsaw Convention[48]. The Space Activities Act of Australia protects the Private Space Entity from compensating for a space accident, to the extent that the amount of compensation exceeds the

---

44 The Outer Space Treaty, 1967.
45 Convention on International Liability for Damage Caused by Space Objects, 1972.
46 The Space Activities Bill § 12, 2017.
47 Commercial Space Launch Amendment Act, 2004.
48 Convention for the Unification of Certain Rules Relating to International Carriage by Air, 1929.

amount insured by the private space entity.[49] Several states in the USA have not only incentivised their participation by providing tax rebates[50] but have also built infrastructure such as space ports in cities of significant interest to the space industry[51] Protecting Small and Medium Enterprises becomes of immense significance to avoid the degeneration of an industry with infinite potential, which can be accomplished by legislators capping the liability on the basis of an entity's financial capabilities

2. Inclusion of a Reciprocal Waiver of Liability Clause

The need for Reciprocal Waiver of Liability Clauses in launch contracts has become very essential.[52] The principle behind this clause is to limit the liability of a private entity for any damage sustained by it during launch operation.[53] Each party will be responsible for any harm to it or its employees. The inclusion of the Reciprocal Waiver of Liability Clause has become compulsory in certain jurisdictions like USA[54] and France. India too should follow in the footsteps of these experienced space faring nations and mandate the inclusion of this clause in contracts revolving around launch operations.

3. Limiting Liabilities for those working jointly with Government

---

49 Space Activities Act § 48, 1998.

50 Fed. Aviation Admin., *State Support for Commercial Space Activities*, http://www.faa.gov/about/office_org/headquarters_offices/ast/media/State%20Support%20for%20Commercial%20Space%20Activities.pdf (Last visited Feb. 13, 2021).

51 Ann Schrader, *Stars Were Aligned for New Mexico's Spaceport*, DENVER POST (June 27, 2010, 1:00 AM), http://www.denverpost.com/business/ci_15382596.

52 Louis de Gouyon, *Space Insurance & Space Law, Space Legal Issues* (August 6, 2019), https://www.spacelegalissues.com/space-insurance-space-law/.

53 Anirudh Rastogi & Kshetragya Nath Singh, *Negotiating a launch contract for a mishap* (November 14, 2016), https://www.thespacereview.com/article/3102/1.

54 Commercial Space Launch Amendment Act § 50914(b), 2004.

Although this recommendation goes against the proposed and drafted provisions of the Space Activities Bill, the need to discuss waiver of liabilities in certain cases is pressing. One such case could be an operation carried and supervised by a private entity to further the interests of the Government. France comes to the rescue again with a precedent statutory provision which allows complete waiver from liabilities of the private entity who has participated in a space activity to target government interests.[55] Austria too provides an insurance cap for activities undertaken by private entities in public interest.[56]

If the government doesn't deem it financially feasible to waive or limit liabilities for all start-ups involved in space operations furthering public interests, what can be done instead is granting a waiver from liability claims, arising out of compensation, to those private entities who have jointly worked with the government to help it achieve its space goals. A detailed draft of regulations prescribing the eligibility to apply for such a waiver could be of immense help to both the private entities and government. In addition to this, a clause stating that these space travels are included under the jurisdiction of the launching state can also be added.

4. Limitation period against ever-lasting liabilities

The liability that the states derive from the liability convention covers events that occur during the launch operation, performance of the designated space activity and even after the space activity has been completed.[57] This is not just inequitable but also disallows the private entity to never escape the mounting liabilities which could

---

55 LOI no 2008- 518 du 3 Juin 2008 RELATIVE AUX OPÉRATIONS SPATIALES art. 14, 2008.

56 Austrian Federal Law on the Authorisation of Space Activities and the Establishment of a National Space Registry art. 4(4), 2011.

57 Convention on International Liability for Damage Caused by Space Objects, 1972.

potentially arise from any space activity. The French have introduced a limitation term in their domestic space legislation, according to which the liability of the private entity would terminate after the designated space activity stands completed and fulfilled for one year.[58] If the Indian legislators allow for the introduction of similar limitation periods against damages, the Indian private space entities will be insured of a healthy business financial cycle which will keep them from wasting their resources on liability claims.

5. Third- Party Liability

It is unfair and fundamentally wrong under many principles of law, when a private space entity is faced with liability claims arising out of a damage which was clearly attributable to the gross negligence of a third party. Protection from such classes of liabilities has not just been sketched out in domestic space legislation but has also been categorically laid down in the liability convention, which shields private parties from liability if the damage was caused due to gross negligence or misconduct from third-party.[59] As detailed out in the earlier sections of this legal note, United States CSLAA has similar provisions which protect private space entities from claims brought due to the misconduct of third parties. India should definitely follow suit.

6. Supplementary Proposals

Apart from the above recommendations, the authors propose the following:

---

[58] LOI no 2008- 518 du 3 juin 2008 RELATIVE AUX OPÉRATIONS SPATIALES art. 13, 2008.
[59] The Liability Convention art. 6, 1972.

a. India should think towards becoming a part of IGA or draft and enter into a Memorandum of Understanding (MoU) with ISS nations to be able to legally dock its vehicles.

b. The Indian Penal Code (IPC) should also be amended and provisions related to offences during space travel or in respect of space tourism should be added.

c. India can also develop a National Space Policy to deal with commercialization of space resources. This policy can be collaborated with the insurance industry to ensure insurance being provided to Space tourists.

The legal team of Swan Airlines signs off on the legal opinion with their two cents being that owing to the stage of infancy of the Space Travel industry, the pioneers of this industry are engulfed with optimism and enthusiasm. According to the authors, the company should not expand its business in this arena until and unless some of the above proposals are adopted by the government. Finally, to quote Dr. Kalam, "we have laws of the sea, air and environment and intellectual property and cyber laws would get a new shape. However, there is a need of law for protection of Indian space above 30 km altitude as the international law on space may not be sufficient."

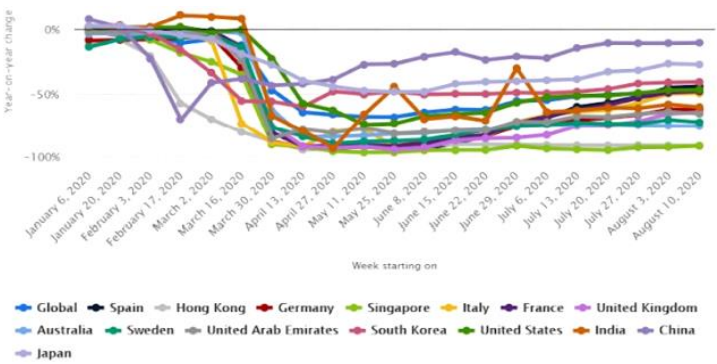
LEGAL AND POLICY ASPECTS THAT NEED FURTHER CONSIDERATION IN THE DEVELOPMENT OF THE FUTURE VISION AND STRATEGY RELATING TO AVIATION, AND SPACE TRANSPORT SECTOR(S)

Shreya Shailesh Karhade & Vaishnavi Santosh Jewoorkar

Introduction

The covid-19[1] pandemic has plunged the Global airline industry into an unprecedented crisis as airline booking plummets in response to regulation and business restrictions on travel increase. Safeguarding consumer and workforce health is priority number one among businesses and government. Toward that aim, continued reduction in air travel will most likely person for a prolonged period.

The crisis raises several unique challenges. In PWC's inaugural covid-19 CFO pulse survey, finance leaders in the United States and Mexico share their top concern.



(Fig 1)[2]

---

1 Covid-19 is also known as Coronavirus. Coronavirus was first detected in the 1960's from sources that are still unknown. It started spreading from China to all over the world in 2019.

2 Source: https://www.statista.com/statistics/1104036/novel-coronavirus-weekly-flights-change-airlines-region/

Uncertainty surrounding the duration or even with the deepening of these conditions adds to a cloud view of how a recovery could play out for the industry. Indeed, the airlines and aircraft manufacturers will likely need Swift Government support. Plants for that are already afoot, not only in the US but also globally. Indeed nosedive in revenue and cash flow seems imminent for most Airlines as well as for the original equipment manufacturers (OEMs) and their suppliers in the aircraft production ecosystem. The international air transport Association estimates the industry will require a cash infusion of up to $200 billion, as well as loan guarantees together with the economic buffeting. Reduction in commercial aircraft orders wide-body aircraft that service Asian hub is likely to the knock-on effect of the global pandemic.

The Coronavirus (covid-19) outbreak is causing widespread concern and economic hardship for consumers, businesses, and communities across the globe the situation is fast moving with the word impacts.

Research and Methodology:

Airlines will likely face a continued downturn in commercial travel and revenue. They will also likely face cash flow liquidity challenges and difficulty managing debt obligations. The same lines may struggle to recover and even declared bankruptcy depending on the effectiveness of government intervention in how long the covid-19 price lasts. The world in the commercial airline industry may well have a secondary and negative effect on the producer of aircraft via a decrease in new aircraft orders are canceled existing ones. Reduced demand for materials and components will likely affect not only the OEMs but also likely reply throughout the supply chains to the supplier.

(Fig 2)[3]

Given the unknown variables in how the covid-19 pandemic will play out and when contaminant will be achieved, the commercial airline should expect to brace for a trial period and plan for a recovery that may not arrive for at least one year, given prior prices the industry has experienced.[4]

Why demand for the products of us defense companies may be protected by government purchasing that may nevertheless experience supply chain structure due to financial impact on partners and suppliers that may have to flow or halt production as in the case of two F-35 Facilities in Italy and Japan that was production.

Steps to consider

- Assess how profitability loans revolving credit and cash flow reserve can support ongoing operation in a lower value

[3] An info graphic depicting the potential economic impacts of Covid-19 on aviation industry. It outlines two possible routes that could occur. https://www.icao.int/sustainability/Pages/Economic-impacts-of-Covid-19.aspx

[4] India careers are looking at 15% to 20% set back its business the worst hit is airline India with 25% loss of business. International Airlines SpiceJet, indigo and Koay are seeing a 15% to 20% slump in business.

environment in light of current cash operating expenses taxes and other cash expenses items.

- Review capital and corporate cost budget to identify not only marginal investments but also discretionary items that can be cut.
- Revisit your capital allocation and cash flow plants to conserve cash during the period of uncertainty as aircraft and air travel demand will likely be impacted for a prolonged period. This should include reassessing dividend and share repurchase plan.
- Consider the vesting known for underperforming assets for assessing mergers and acquisitions prospects as a potential source of cash.
- Consider refinancing debt.
- Urge and help co-ordinate Government support through a package of initiatives including guaranteed loans, deferred taxes, and similar measures. At the same time, urge relevant government agencies to increase intergovernmental coordination and collaboration to help protect the industry from bankruptcy risks.

How Aviation and space Sector affected?

Several other sectors are facing a crisis in the wake of the Covid-19 pandemic. Which travel restrictions, grounded fleets, benched staff, schedule uncertainties, ticket liabilities, and cash burn, questions are being raised on whether the Civil Aviation Sector can survive the epidemic?

Aviation in the space chapter is an essential engine of the economy of India space and the aviation sector contributes a lot to the economic growth of India. Due to the bad effect of the covid-19

Aviation and space Sector affect a lot in April, May, and June. The airline sector is shutdown.

It is an unprotected situation in a world in which fluid borders international travel is high risk has covid-19 (Coronavirus) is caused it pandemic and aviation sector is the hottest it.

India's careers are looking at 15 to 20% setbacks its business the worst hit is airline India with a 25% loss of business. the airline canceled all the flights to China, Korea, and Italy e it also reduces The frequencies to the United States, and Europe among travel airline Vistara has canceled 54 International Airlines SpiceJet, Indigo and Koay are seeing a 15 to 20% slump in business.

Air India has told CNN news 18 that the situation is cute and more flights could be canceled after our assessment on 28 March SpiceJet was The Lone airline to advertise cheaper tickets through full-page newspaper ads amid the crisis CMDs Jason quoted that I got the aviation sector is under a lot of pressure but this is temporary we have been ahead of the for SpiceJet is far that that is an opportunity for SpiceJet for the Government and the aviation ecosystem to create more efficient for a well valuable structure for the growth that lies ahead SpiceJet will emerge is stronger from this unquote.

What needs to be done to manage the crisis?

It can already be anticipated that the post-crisis Aerospace industry will not look like it did before the crisis:

1. Significant downsizing of operations is to be expected from both OEMs and suppliers

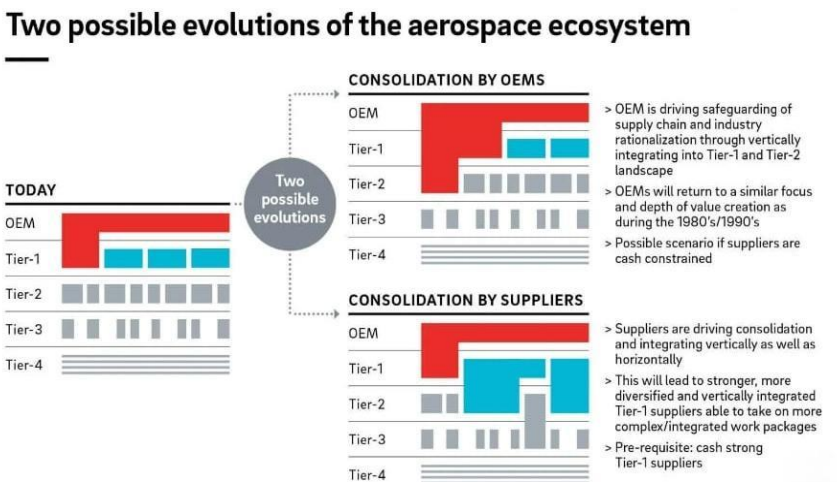
The interesting will need to offset the result in loss of scale with the setup inefficiency, potentially take advantage of the crisis to take actions that would be unpalatable in easier times.

2. Weaker Suppliers (e.g. Doors with having exposure to the b737, more aftermarket exposure, and less countercyclical defense business) will come under severe financial pressure.

3. Significant consolidation of the industry bike companies with a strong balance sheet must be expected Ida to take advantage of the distressed asset or to bail out suppliers to safeguard the stability of their supply chain.

One of two possible post-crisis industry models could emerge:

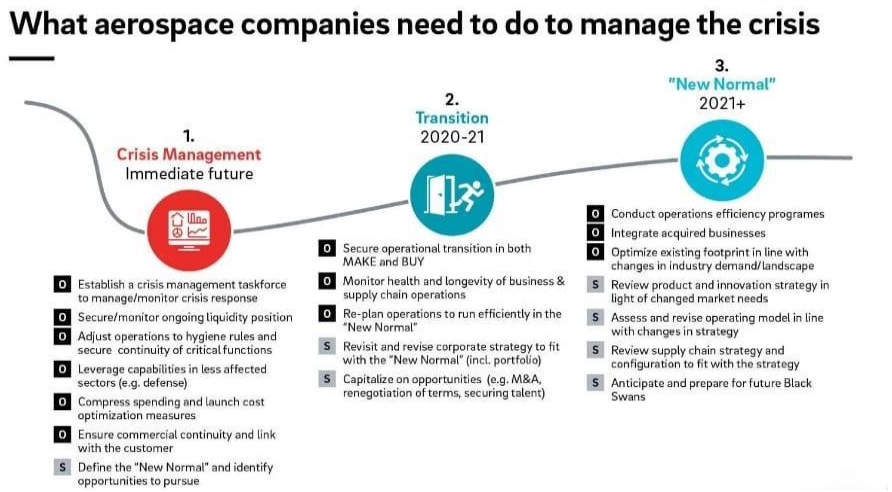
- A more OEM-Centric industry model whereby the OEMs and key Tier-1 Suppliers, where the Tier-1s I have consolidated, even more, amassed scale and are now on a level playing field with the OEMs.



(Fig. 3)

Is the Aerospace industry relies on a highly interconnected and mutually dependent supply chain, the crisis needs to be managed on two levels in parallel:

On an individual company level, cash will be king. protecting cash position will be the key to ensuring survival while managing the ramp down, stabilizing and securing the supply chain, and seizing opportunities in the market- we may therefore expect squeeze in May and Junes new production schedule become established but activity is have not yet been rationalized. Preparing for the "new normal", right-sized and potentially repositioned operations must start immediately. To this end, the company's strategy its industrial footprint, and operating models need to be reviewed and a blueprint developed to fit with the new normal and provide the right Framework for the short-term actions and strategic moves.



(Fig 4)

At the industry level, companies and government will need to work closely together to ensure that key interesting capability does not fall

through the cracks as this would put the whole industry at risk. Therefore the industry will have to:

- Quickly reach a consensus on the new normal production rates.
- define a joint plan for how to transform the industry from its status quo to the new normal level
- Identify at-risk elements in the transition process and develop plants to support them.

This picture is cleared out to be called upon to safeguard the short-term functioning of the industry and help manage the transition to the new normal for this strategically important sector.

India, in particular, has done to bring back suppliers on domestic routes while International passenger's services continue to restrict and operated under travel bubbles through a bilateral agreement with partner countries. Interestingly, the air cargo market has continued to grow steadily to meet the increasing demand for food essential and medical aid. The fall in passenger demand has also prompted many careers to retrofit aircraft to carry more cargo across borders, in search of better margin and cash flows.

As with any major crisis, Covid-19 and its economic ramification have present both challenges and opportunities.

Let's examine the ***challenges that industry faces*** as it tries to recover from its precipitous fall.

1. **Rationalization of Corporate Travel-** Even as markets recover, the increasing adoption of Technology and work from home routines are likely to reduce demand for business travel significantly. Some experts estimate this to be higher

than 40%, as employees and traditional Jetsetters become more comfortable with better and cheaper technology and hybrid workspaces. The need to conserve cash and reduce cost, in the long run, will reinforce such behaviors as businesses struggle to restore profitability and value of shareholders. Airlines and airports will have to contend with this new normal innovation and rejig their growth strategies accordingly.

2. **Drop-in commercial revenues-** The need for social distance and personal hygiene while traveling has already hurt passengers' spends within the terminal significantly.

   Commercial or non-aeronautical revenue is a rich source of income in airport businesses, more than 50% of overall revenue in many mature airports, a large proportion generated by duty-free retail which has completely dried up with Limited or absent International footfalls. Job loss, rationalization of salaries, reduced economic growth, and lower disposable income are likely to exacerbate the impact in the future reducing footfalls and spends both at airports and in flight. airport owners will need to transform their commercial business and operating models to deal with this new reality but will be held by advances in technology and the growing popularity of the digital platform.

3. **Market distortions-** Airlines have suffered heavy losses in revenue from the pandemic, threatening the survival of many, especially given the nature of the business. Financially solvent governments (US, Germany, Singapore, UAE, Japan among others) have stepped to provide relief to many national Carriers through grants of loans credit

guarantees, and other forms of support. private careers have not been equal beneficiaries in such a market with minimal or no support at all from regulators or government potentially Jeopardizing competitive tension and aggravating market distortion that can impact both choice and fares for flyers in the future.

4. **Impact on future investments and asset rebalancing-** In growth markets like India have created the capacity to over the last two decades. In some airports, capacity has either been built upfront or being created with significant costs already incurred. While the long term outlook for growth remains strong in underpenetrated air markets like India, the next three to four years are going to pose significant challenges for airport owners and investors to monetize assets for the purpose than to create shareholder value. In some cases, competition from newer assets light airports may also cause an additional challenge on asset rebalancing and profitability.

5. **The double whammy for regulators-** A combination of factors, such as weak demand Outlook, poor revenues, high asset servicing cost, and low liquidity appears to have what regulators across the world in a Perfect Storm. Compensating airports on the current business model without imposing an additional pricing burden on Airport principal users- Airlines, passengers, commercial business- a present major conundrum for regulators. In some cases, they also must make difficult decisions in fairly and equitable he located in airport us that such as slots and real estates.

The contract of covid-19 on the radiation chapter has been worked but it has also provided an opportunity for the industry to reimagine its future. Here are five ways in which it could be done:

1. **Refocus on the cost-line:** Innovations in design, technology, and financing can significantly change the cost of providing services for both airlines and airports. It can help deliver more bangs for the buck and questioned the pressure on both affordability and profitability. Solar-powered airports, electric bussing, green buildings, and recycling can engender significant savings in operating costs and could become the norm for the best performing airports.
2. **Make technology work harder for you-** In a progressively digital world, the bike carries more value than bricks if used well. Investing in the right tool and Technology cannot help monetize assets better but also significantly improved operating efficiency and customer experience.
3. **Transform the operating model-** Technology can facilitate a complete revamp of the operating model for Greenfield assets. For example, touchless check-ins, RFID bag tags, contactless and paperless immigration, and boarding processes can largely obviate the need for large passenger concourses and check-in areas and release more monetizes in more commercial spaces. Sustainability tune that can enhance access productivity and unlock value by effectively managing life cycle costs. Another important consideration would be to find the right balance between resilience and efficiency.

4. **Collaborate-** airlines and the Air force have often been adversaries in a commercial ecosystem but may have a lot to gain from each other in-demand constant prices sensitive market. Data could be the key to maximizing value and sharing games for mutual benefit. It could not only help extend the clientele beyond airport boundary but also help optimize cost while providing more value for passenger and airport users.

5. **Innovative-** history has shown us that crisis has spawned the best inventions and innovations. The immense value of data and technology that we have access to today cannot be overstated. They act as a perfect lever to invent and innovate solutions that can boldly take on a world shaped by volatility, uncertainty, complexity, and ambiguity.

There is a need for a sharp rational and consistent approach to Reform to help the industry cruise at a newer and higher altitude and redefine its new normal. The changing geo-political scenario and impeding powers Swift globally also demand a swift and adroit approach. Accident policy changes will be required to exploit the opportunity, strategic gains and create a better future.

As we looked to establish what a post-covid-19 aviation sector might be like, it's difficult to get past the human cost and statistics, particularly site working from the confines of our homes.

Over 40 major airlines have ground at their athletes and most have suspended over 90% of their flights. Moreover, some of them financially secure Airlines, including the life of British Airways have been stated they are in a fight for survival despite having both a robust balance sheet and long that is from parent company IAG.

Lufthansa is permanently reducing the size of its plate and shuttering one of its low-cost carriers. SAS also announced that it expects demon to take years to recover and is reducing the size of its workforce by 500 staff to respond to market conditions.

Furthermore, the current lack of testing data from the globally Patna population makes it's nigh on impossible to evaluate how long the crisis might continue and how long we might remain unable to travel.

Aviation is fundamental to the support and growth of local and global economics and an essential part of our world as travelers. So here are some ***changes that the aviation industry can make to support recovery*** and how this fits in with long-term goals do.

1. **Restoring Traveller confidence in air travel:**

   In the short term, we can realistically expect countries to keep the borders closed, so domestic travel will initially return, followed later by international flights. Travelers will undoubtedly be nervous, so responsibility will fall to airports to reassure and access Travellers that they are taking every precaution to safeguard their health and safety. The industry will need to respond to additional health screening facilities washroom cleaning facilities will also require at least temporary modification to existing airport facilities. The possibility of flexibility and for a longer period than any of us would like.

   Technology will need to be quick to respond to challenges and suppliers are already looking at touchless triage at the self-check-in facilities. This would automatically suspend travel if the customer vital sign displayed potential symptoms and would

reduce the risk of Transmission before the individual came into contact with other passengers or staff.

The challenge for most airports trains in the availability of self-check-in booths and an ability to retrofit new technology to existing hardware.

2. Accelerating the creation of seamless passenger journey:

Not a new concept to the aviation industry but this pandemic could accelerate the development of the biometrics and statistical analysis of physical and behavioral traits to automatic Traveller recognition.

Processes that avoid physical contact and the natural choke points where Travellers you through security and border control but Bastila improve passenger's experience and reduce the future potential for transmitting disease.

Equally the replacement of travel documentation with facial recognition simplifies that normal process of check-in, in bag drop, border control, security clearance, and boarding. Again, this would dramatically reduce wait times, queuing, and improve the experience and lessen the potential for an infected individual to contaminate others. Whilst technology is developing to make this a reality it requires significant investment and trying because they will see widespread uptake. At a time when the budget will be stretched to breaking point, it seems third-party investment would be essential to support cash-strapped airports, who in the short term for the struggle to justify cost-benefit returns.

3. Maximizing the value of predictive maintenance regimes.

The Orbis opportunities for most airports during a quarter are for maintenance and repair of core infrastructure. In a time where managing cash flow will be critical, the focus must be placed on ensuring that these works deliver long-term performance safety and importantly OPEX savings.

Avoiding reactive maintenance to protect cash flow from most Airports is critical. The ability to accurately predict maintenance requirements will help support their long-term financial planning and ultimately capture and quantifier savings.

Tailored predictive maintenance can deliver savings above 30 % on annual maintenance costs, which will support and safeguard airports' challenge budgets when needed most. Opportunities still exist to modernize and develop in any programs and also takes lessons learned from other sectors e.g. Utilities, which have embraced these Strategies for many years and reaped the benefits.

4. Accelerating the journey to net-zero.

Aircraft are frequently singled out for accounting for 2% of global carbon dioxide emissions. Manufacturers are working on lighter more fuel-efficient plates with alternative fuel but Air Force themselves also have a part to play in moving towards net-zero carbon. In late 2019, 200 members of ACI Europe, the trade association for European airports, permitted to produce net-zero carbon emission by 2050. Others like Swedavia have gone further with a commitment to meet this goal as soon as 2020 for Stockholm Arlanda Hub. The current hiatus of Aviation activity

offers an opportunity to consider how the covid-19 crisis could expedite a zero-carbon airport.

Initiatives to drive the journey must be integrated across the terminal, airfield, and border infrastructure of an airport. This needs to consider how the airport can encourage the use of low carbon planes, for example offering lower landing fees to these aircraft. Other considerations are reduced taxiway times, access to low carbon or zero-carbon energy sources for stand power, and low carbon fuel for heating/cooling of terminals.

All these initiatives need to be framed within an overarching strategy and linked to data-driven solutions and roadmaps, which consider and airport activity from surface transportation to the operation and ongoing development of the assets.

Space Sector

As a component of the digitalization of the economy satellite science and information assumes an inexorably essential job in the productive working of social Orders and their monetary turn of events. The new development in the area has created uncommon degrees of business ventures and startup action. Notwithstanding, with the covid-19 emergency, this positive pattern would be turn around. While many space areas appear to have the option to adapt, a critical number is battling, especially little and medium-size individuals that style is the main part of business entertains in the space business. Thinking about significant expenses of passage to the area, there is a danger that emergency could prompt more industry focus take out more modest and more useful forms that are the key wellspring of development business and financial development. Space organizations and other public organizations

accordingly need to about weak more modest entertainers and their general emergency reactions.

As a part of the digitalization of the economy, satellite Signals and data play an increasingly pivotal role in the functioning of societies and their economic development investment in space programs contribute to dry scientific exploration, knowledge, technology, development, and advances in products and services. Several space chapter activities such as space manufacturing and satellite telecommunication, in many OECD countries, are designated as national critical infrastructure sectors that are considered essential for the functioning of a society and economy, as well as for the continued safety and well-being of the population.

During the covid-19 crisis, space manufacturers and Agencies have actively contributed to the response efforts, by producing medical equipment; provide free storage and processing capabilities for modeling and other research needs, and studying impacts. The space Sector has also provided high-speed connectivity to the remote locations as well as Earth observation imagery for industry Intelligence and monitoring of remotely located infrastructure.

Negative impacts on smaller and younger firms

While most firms seem to be able to cope, still a significant number is struggling. For large space manufacturers, the crisis has often mainly slowed down product deliveries and mission deployments, due to social distancing measures and supply delays, with only limited effect on revenues. Government contractors in North America Europe and Asia have benefited from significant administrative and financial support from space agencies through

accelerated and advance payments and licensing with local and regional authorities to keep facilities open.

The most significant negative short term impact has been concern among smaller suppliers, many of which are dependent on contract from large pores and must wait for the payment to Trickle down. In a recent survey of space Sector firms in the United Kingdom, 20% report significant or critical economic damage to their business, 63% report some impact, while 18% of respondents report little off no current impact. Medium-term forecasts are more Pessimistic, as restrictions on travel and large gatherings make it difficult to generate new business, and concerns about future government contracts are growing.

In Korea, some 66% of Space companies surveyed in March by the Korea Association for space Technology promotion anticipated negative impact throughout 2020, with 42% expecting to recover business in the first half of 2021, although 22% were anxious about future business.

in the United States, Department of Commerce study on space industrial base found that 92% of space firms with research and development (R&D) as a primary Business Line were small businesses, open sole source providers of critical parts, equipment, and services. US Government Agencies have expressed particular concern about these small firms and subcontractors in the strategic supply chain of small rockets, commercial satellite Communications, and microelectronic segments, with the US space force acquisition Council launching a dedicated server for the suppliers. Another survey conducted among European SMEs in the space Sector revealed that 70% of respondents already had cash flow constraints in April 2020. A month later the lack of long-term

research and development projects and commercial orders became the main concerns.

As in other industry sectors, startups are particularly vulnerable to the current crisis. In March, The satellite operator one web, one of the companies developing a service for satellite broadband in the low Earth orbit, filed for bankruptcy protection after it failed to raise sufficient financing for completing its constellation. a German survey specifically targeting space startups reveal that almost 40% of respondents report the impact of covid-19 are dramatic and threaten The very existence of their firm, with 80% of the surveyed Startups considering existing Government support measures insufficient.

Amazon's concern of startups is the lack of visibility of future contracts, with clients and private investors putting decisions on hold. The restrictions on international travel and cancellations of conferences and trade fairs also make it much more difficult to make new business deals. These findings are echoed in similar industry consultations in Canada and France.

Overall evidence from this growing number of industry surveys and consultations several OCED countries suggest that SMEs and entrepreneurs in the space Sector may be falling between the cracks of available government measures.

- All actors are concerned about the long-term impacts of the crisis on funding for government programs and procurement, as this directly and indirectly supports and attracts an increasingly Complex ecosystem of contractors subcontractors startups, and private investors.

- SMEs have a fun problem identifying and navigating appropriate support programs finding them hard to understand.
- Eligibility is a problem for some actors.
- High cholesterol requirements in a hurdle in several cases and startups backed by venture capital firms often do not qualify for support.
- Procurement agency administrative processes are considered to be too slow to be effective.

Key Recommendations

Space Agencies and other public administration, as funders or anchor tenants of space R&D, Products, and Services, Have acted swiftly and are easy to ensure the continuity of space operations and accelerate and are procurement procedures. However, more targeted measures may be needed for the smallest and most vulnerable actors, to sustain a diverse and innovative space ecosystem, following policies can be considered:

1. ASCII institutional customers to the space industry, space agencies, and other public administration need to consider vulnerable smaller after fully in their overall crisis response, simplifying procedures and adapting eligibility criteria for support and procurement programs, to facilitate access to public and private funding (e.g. Accelerated and advance payment, liaising with local and regional authorities to keep facilities open).
2. Increase the visibility of existing and new government long-term space programs and their funding schemes enabling

firms to retain needed skilled staff and reassure their investors.

3. Reinforce existing measures such as business incubation centers and product testing and demonstration schemes, addressing particularly the need of SMEs and entrepreneurs (e.g. encouraging reduced or no access fee to access testing facilities).

4. Keep track of who is doing what. Overall, more high-quality data is needed about the space industrial base to inform policy decisions.

Conclusion

The paper concludes that policy needs some implementations in the aviation and space transport sector. The results of this study Might Allow the Development of a more proficient Strategy relating to the Aviation and space transport sector. The current policy is a part of research project to draft a policy on Aviation and space transport sector(s).

COLLISIONS IN OUTER SPACE: ASSESSMENT OF LIABILITY

Sayan Dasgupta and Saumya Raj

Introduction

With mankind creeping into development and exploration of every crevice, expansion into outer space is no exception. With such a foray of outer space activities and outer space objects, risk follows suit. A great American astronomer, Simon Newcomb once wrote "The demonstration that no possible combination of known substances, known forms of machinery and known forms of force, can be united in a practical machine by which man shall fly long distances through the air, seems to the writer as complete as it is possible for the demonstration of any physical fact to be."[1] The history of academicians and scientists linking avant-garde innovations and ideas with technological reality which seemed impossible and virtual now is more apparent and real in the present century. Conjuring abstract ideas through human processes, discoveries, inventions and scientific explorations makes impossible ideas a reality every day.[2] The fascinating new reality comes bearing opportunities and benefits; along that comes problems that threaten the human civilization in whole or part. The most lethargy visible is on part of the law- the social tool to alleviate the problems. Often caring very little of the technological advancements, law gets stifled and laggard.

---

1 George Paul Sloup, *Peaceful Resolution of Outer Space Conflicts through the International Court of Justice: The Line of Least Resistance*, 20(3), DEPAUL LAW REVIEW (1971). *See* generally, Baldwin, *Law of the Air Ship*, 4 AM. J. INT'L L. 95 (1910).

2 *Id.*

The exploration of space *per se*, the moon, and the celestial bodies may result in causing harm to person and property. The domain of space is primarily for peaceful and non-aggressive purposes, and beneficial to mankind albeit noteworthy to recognize the dangerous consequences, as was seen in the ill-fated event of *Cosmos 954.* Canada on January 23, 1979 demanded that Soviet Union pay for the damages caused by the mishap of *Cosmos* amounting to $6,041,174.70 which was later reduced to $6,026,083.56[3] with respect to costs incurred by the State which would not have been sustained had the satellite not entered the State territory.[4] The claim of damages was validly raised under the 1972 international agreement of International Liability for Damages Caused by Space Objects, however, the matter never gained traction in the Courts for an extrapolation of the issue of such damages caused due to space objects.

In 2011 and 2012 respectively, a defunct NASA[5], a German[6] satellite and a Russian probe[7] crashed on the Earth surface. Where

---

3 Carl Q. Christol, *International Liability for Damage Caused by Space Objects*, 74(2), THE AMERICAN JOURNAL OF INTERNATIONAL LAW, Cambridge University Press (1980).

4 Government of Canada, Department of External Affairs, Communique No. 8, January 23, 1979. Canada also worded that its claim from the Soviet Union was without any prejudice and further damages could be claimed based on discovery of new consequences and harms caused due to the satellite, *Cosmos*. Correspondence between the two States in laid down in 18 ILM 899 (1979). Canada also claimed damages under the head of recovery operations and search of the parts and the decay and residue of the satellite.

5 Kenneth Chang, *Satellite Ends Fall, Likely in the Pacific*, N.Y. TIMES, Sept. 25, 2011, at A20, available at http://www.nytimes.com/2011/09/25/science/space/25satellite.html?_r=1.

6 Jonathan Amos, *German Rosat Spacecraft Makes Uncontrolled Re-entry*, BBC NEWS: SCI. & ENV'T, Oct. 23, 2011, http://www.bbc.co.uk/news/science-environment-15402157.

7 Alex Knapp, *Failed Russian Probe Phobos-Grunt Will Fall to Earth This Weekend*, FORBES (Jan. 13, 2012, 2:06 AM), http://www.forbes.com/sites/alexknapp/2012/01/13/failed-russian-probephobos-grunt-will-fall-to-earth-this-weekend/.

such satellites falling on the surface garners public and media attention, collision that could occur due to the space debris or residue, and space objects still remains an unventured hazardous domain. This manmade space junk orbiting the planet not only pollutes[8] but also could lead to unforeseen collisions[9] amounting in huge damages; some of which could endanger future prospects of space exploration and discovery.[10] Allocation of liability and raising claims for space debris and collisions would also prove difficult since the present treaties of liability are rudimentary and ambiguous. Ascertaining liability becomes even more challenging due to the limited ability to track defunct and rogue space objects and/or space debris.[11] Hitherto, only one claim has been brought forth on grounds of treaty of space liability, which was later settled[12]; therefore, a missed opportunity for development of law in that regard.[13]

The present note and analysis are in view of accomplishing the same principal objective of determining liability in a hypothetical scenario of a collision between uncontrolled space object and/or space debris.

Review of Major Space Treaties and Agreement

---

8 John Matson, *On the Trail of Space Trash*, SCI. AM., Nov. 2011, at 18, available at http://www.scientificamerican.com/article.cfm?id=on-the-trail-of-space-trash.

9 Luke Punnakanta, *Space Torts: Applying Nuisance and Negligence To Orbital Debris*, 86(163), SOUTHERN CALIFORNIA LAW REVIEW (2012).

10 *Id*.

11 Mark J. Sundahl, Note, *Unidentified Orbital Debris: The Case for a Market-Share Liability Regime*, 24 HASTINGS INT'L & COMP. L. REV. 125, 133 (2000).

12 Van C. Ernest, *Third Party Liability of the Private Space Industry: To Pay What No One Has Paid Before*, 41 CASE W. RES. L. REV. 503, 524 (1991). *See* also, Luke Punnakanta *supra* at 9.

13 Andrew Brearley, *Reflections upon the Notion of Liability: The Instances of Kosmos 954 and Space Debris*, 34 J. SPACE. L. 291, 310 (2008).

States signing regional and bilateral accords impacting space law generally work under the principles stated in the five main treaties and agreements that form the organizational structure of space law.[14]

These five treaties and agreements are:

1. The Outer Space Treaty;[15]
2. The 1968 Agreement on the Rescue of Astronauts, and the Return of Objects Launched into Outer Space;[16]
3. The Convention on Liability;[17]
4. The 1976 Convention on Registration of Objects Launched into Outer Space Registration Convention;[18] and
5. The Moon Agreement.[19]

Some of the other important accords and agreements include:

1. The Comprehensive Nuclear Test Ban Treaty;[20]
2. The International Space Station Agreement;[21] and

---

[14] 0 LH. Ph. Diederiks-Verschoor, An Introduction to Space Law 9 (1993).

[15] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, done JaJan. 27, 1967, art. I, 18 U.S.T. 2410, 2412, 610 U.N.T.S. 205, 207 (the Outer Space Treaty).

[16] The Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched Into Outer Space, Dec. 3,1968,19 U.S.T. 7570,672 U.N.T.S. 119 (the Rescue Agreement).

[17] See generally Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 (the Convention on Liability) (addressing liability issues concerning damage caused by outer space objects).

[18] Convention on Registration of Objects Launched into Outer Space, Sept. 15,1976, 28 U.S.T. 695,1023 U.N.T.S. 15 (the Registration Convention)

[19] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, adopted Dec. 5, 1979, art. 11, 1363 U.N.T.S. 3, 25 (the Moon Agreement).

[20] G.A. Res. 46/29,46th Sess., U.N. Doc. A/Res/46/29 (1991).

[21]See Agreement Among the Government of the USA, Governments of Member States of ESA, the Government of Japan, and the Government of Canada on Cooperation in the Detailed Design, Development, Operation, and Utilization of the Permanently Manned

3. The International Telecommunication Union.[22]

Of the five main treaties and agreements, the Outer Space Treaty is the most important.[23]This treaty embodies the belief that outer space exploration and the resulting exploitation and distribution of outer space resources are international and altruistic endeavours.

The Outer Space Treaty provides that space exploration is for the benefit and interest of all countries.[24] Outer space is not subject to "appropriation by claim of sovereignty, by means of use or occupation, or by any other means."[25] The general rule that outer space is not subject to appropriation has an exception, which allows a limited property right to use and possess a restricted number of valuable orbits within the GSO for deploying satellites. The exception is similar to a zoning variance and has characteristics analogous to a property easement. The non-appropriation principle remains intact because the entity using an individual orbit has only a non-freehold interest, not a fee simple absolute ownership interest. Individual orbits are like property lots because they can be held without being developed.

The Rescue Agreement provides for obligations regarding assistance to astronauts.[26] Article V includes procedures for returning space objects found by a sovereign state in its territory. The launching state is required to reimburse all costs involved in recovering the space object, even if the space object is in the territory

Civil Space Station, Sept. 26, 1988 in Space Law: Basic Legal Documents, Section D.II.42 (K-H Bocksteigal & M. Benko eds)

22 http://www.itu.int/home/index.html

23 See Diederiks-Verschoor, supra note 1.

24 See the Outer Space Treaty, supra note 2.

25 Article II

26 See the Rescue Agreement, supra note 3.

of another sovereign state. The Rescue Agreement provides that the launching state retains ownership over the space object.[27]

Articles II and IV (a) of the Convention on Liability establish an absolute liability requirement on the launching state for damage caused by a space object on the surface of the earth or to an aircraft in flight. Articles III and IV (b) provide for standard fault liability for damage caused by a space object somewhere other than on the surface of the earth. If two or more states launch jointly, Article V provides that the states are jointly and severally liable. The Convention on Liability provides procedures for filing claims; however, such procedures do not apply to damage caused by a space object of a launching state to a national of that launching state.[28]Moreover, private citizens must petition their government to bring their claims to the Convention Claims Commission because the Convention on Liability covers only sovereign states.[29] Article X of the Convention on Liability provides that states must attempt to resolve claims by diplomatic means first and can invoke the Convention Claims Commission only if unable to reach a settlement. The statute of limitations is one year following the time of the damage or one year after the plaintiff has identified the launching state.[30] Article XIV provides for the establishment of a Claims Commission at the request of either party if diplomacy fails to effect a settlement. The Claims Commission has three members, one appointed by the launching state, one appointed by the claimant state, and the third member, the Chairman, appointed by both parties.[31] The Convention on Liability does not provide any role for

---

27 Nandasiri Jasentuliyana, International Space Law and the United Nations 2 (1999).
28 Article VII (a)
29 Article VIII
30 Article X
31 Article XV

the International Court of Justice. Article XIX provides that the Claims Commission has no enforcement power because the award is recommendatory. Article 26 of the Vienna Convention provides that "every treaty in force is binding upon the parties to it and must be performed by them in good faith."[32] Moreover, members of outer space treaties and agreements are bound to follow the United Nations Charter in carrying out outer space exploration.[33] The United Nations Charter provides that "members... shall fulfil in good faith the obligations assumed by them in accordance with the present Charter."[34]

Addressing Liability under the Liability Convention

The *corpus juris spatialis* is founded on five international instruments drafted by the United Nations Committee on the Peaceful Uses of Outer Space: *firstly*, the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (the 'Outer Space Treaty'),[35] *secondly*, the Agreement on the Rescue of Astronauts and the Return of Objects Launched into Outer Space (the 'Rescue and Return Agreement'),[36] thirdly, the Convention on International Liability for Damage Caused by Space Objects (the

[32] Vienna Convention on the Law of Treaties, May 23, 1969, art. 26, 1155 U.N.T.S. 331,339.

[33] See U.N. CHARTER art. 2, para. 2.

[34] Id

[35] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (adopted 27 January 1967, entry into force 10 October 1967) 8 UST 2410, 610 UNTS 205.

[36] Agreement on the Rescue of Astronauts and the Return of Objects Launched into Outer Space (opened for signature 22 April 1968, entered into force 3 December 1968) TIAS 6599; 19 UST 7570.

'Liability Convention'),[37] fourthly, the Convention on Registration of Space Objects Launched into Outer Space,[38] and fifthly, the Agreement Governing the Activities of States on the Moon and other Celestial Bodies (the 'Moon Treaty')[39].

Space Objects

Article I(d) of the Liability Convention[40] does not lay down an exhaustive and unambiguous definition of "space object" including "component parts of a space object as well as its launch vehicle and parts thereof." [41] Artificial space objects are objects that are launched into the outer space for commercial or scientific or industrial intent.[42] The intent and the activity it is engaged in gains more pertinency since international space law fails to provide a formal definition of the boundary between airspace and outer space.[43] The space object majorly engages in engaging in missions assigned to it while in orbit and return back to the surface of earth safely.

Ergo, whilst the space object transits the airspace, its principal activities and assignments are not confined to it. Notwithstanding the definition being inclusive, Article I(d) lacks mention or

---

37 Convention on International Liability for Damage Caused by Space Objects (opened for signature 29 March 1972, entry into force 1 September 1972) 24 UST 2389, TIAS 7762, 961 UNTS 187.

38 Convention on Registration of Space Objects Launched into Outer Space (adopted 14 January 1965, entry into force 15 September 1976) 28 UST 695, TIAS 8480, 1023 UNTS 15.

39 Agreement Governing the Activities of States on the Moon and other Celestial Bodies (opened for signature 5 December 1979, entered into force 11 July 1984) 18 ILM 1434, UN Doc A/RES/34168 of 14 December 1979.

40 *Supra* at 16.

41 *Supra* at 16.

42 Joel Stroud, Space Law Provides Insights on How the Existing Liability Framework Responds to Damages Caused by Artificial Outer Space Objects, 37(2), REAL PROPERTY, PROBATE AND TRUST JOURNAL, 365 (2002).

43 Carl Q. Christol, *supra* at 3 at 348.

reference of either control over the space object or the functionality.[44] Therefore, loss of control or a defunct space object would remain a space object thus liable equally imputing liability under Article III of the Liability Convention[45].

Incurring Liability under Liability Convention[46]

Principle of absolute liability is applied to internationally ultra-hazardous acts which includes outer space activities and nuclear activities.[47] Article VII of the Outer Space Treaty[48] sanctions an international liability on launching states[49] who cause harm or any kind of damage[50] to the State party to the treaty or natural or judicial persons thereof caused by the space object on the surface of the earth, airspace or outer space[51]. The generality observed in addressing the liability in the treaties could be emblematic of the necessity to not limit the scope of liability and to give it room to grow.[52]

Liability would also be absolute in case of damage caused to any third state on earth surface or any aircraft in flight as a consequence of a damage inflicted to a space object or any of its personnel by

---

44 Bin Cheng, *Legal Status of Space Crafts, Satellites and Space Objects*, STUDIES IN INTERNATIONAL SPACE LAW 462, 464 (2004); Stephen Gorove, *Towards the Clarification of the term "Space Object"- an International Legal and Policy Imperative?* 21 J. SPACE L. 11, 16 (1993).

45 *Supra* at 16.

46 *See* H Dessaussure, *Do We Need A Strict Limited Liability Regime in Outer Space?*, 22 PROC. COLL. ON THE LAW OF OUTER SPACE, 113 (1978); Jenks, *Liability for Ultra-Hazardous Activities in International Law,* 1 RECUEIL DES COURS, 105 (1966).

47 *Id*.

48 *Supra* at 14.

49 Article I(c) of the Liability Convention, *supra* at 16.

50 Damage as defined under Article I(a) of the Liability Convention, *supra* at 16.

51 Zeldine Niamh O'Brien, *Theories of Liability for Space Activities*, 15 ISLR 44 (2007).

52 Carl Q Christol, *The Modem International Law of Outer Space* (Pergamon Press, New York 1982) 90.

another State's space object; wherefore, both the latter states would be jointly or severally liable to the third state.[53] Save that, any damage caused to the space object of third State anywhere other than surface of earth or aircraft in flight would equate to a fault-based liability.[54] A launching State however can be exculpated from the liability if there is an observation of gross negligence or any intentional act or omission causing the damage on part of the Claimant State.[55][56]

Application of Treatise of Space Law on Hypothetical Scenario of Collision of Uncontrolled Space Objects/Space Debris

The moot situation is not completely unprecedented. China in 2007 in its own volition destroyed a defunct weather satellite which possibly added millions of pieces of debris to the already significant amount of pollution existing in outer space. This could most likely lead to several cascading disasters making outer space a hostile environment for exploration.[57] The ill-fated incident of *Cosmos 954* is another instance.[58]

In the hypothetic, the launching State would be imputed under fault-based liability under Article III of the Liability Convention.[59] It is submitted that "fault" has not been defined under the Liability Convention. "Fault" however under *corpus juris spatialis* has been

---

53 Article IV(1)(a), Liability Convention, *supra* at 16.

54 Article III, Liability Convention, *supra* at 16. The fault-based system is also applicable to damage to a State's space object by another State.

55 Article VI, Liability Convention, *supra* at 16.

56 *See* generally, Edward F. Hennessey, *Liability for Damage Caused by the Accidental Operation of a Strategic Defense Initiative System*, 21(2), CORNELL INTERNATIONAL LAW JOURNAL (1988).

57 Lieutenant Colonel Joseph S. Imburgia, *Space Debris and Its Threat to National Security: A Proposal for a Binding International Agreement to Clean Up the Junk*, 44 VAND. J. TRANSNAT'L L. 589, 592 (2011).

58 Joel Stroud, *supra* at 21.

59 *Supra* at 33.

consistently interpreted as a negligent act.[60] Furthermore, Article 31 of Vienna Convention[61] which provides for codification of customs[62] records that recourse may be had to international law to interpret terms based on necessity. Under general international law, fault has always been constituted by negligence[63] *viz.*, undesirable consequences which are reasonably foreseeable under ordinary prudence[64] wherein, the standard for negligence is due diligence[65]. Due diligence ipso facto requires the launching State operator to oversee every risk and harms conceivable and attempt to prevent the said collision.[66] Such a standard of due diligence is further heightened since space activities are ultra-hazardous in nature.[67]

The launching State must therefore must adhere to four infallible norms: *firstly*, duty to forewarn, *secondly*, duty to provide information, *thirdly*, duty to clean up, and *fourthly*, duty to compensate. Launching State's conscious decision of governing and tracking its space objects to prevent collision or lack thereof is a national activity; notwithstanding derelict or not. Article VIII of the

---

60 George Hacket, *Space Debris And Corpus Juris Spatialis*, 180 (1994); Howard Baker, *Space Debris Legal Policy And Implications*, 84 (1989); Stephen Gorove, *Liability in Space Law: An Overview*, 8 ANNALS. AIR & SPACE. L. 373, 376 (1983).

61 Vienna Convention on the Law of Treaties, entered into force on Jan. 27, 1980 Article 31(3), 1155 U.N.T.S., 331

62 Dispute Regarding Navigational and Related Rights (Costa Rica v. Nicaragua) (Merits) 2009 I.C.J. 214, 237 (July 13).

63 Antonio Cassese, *International Law*, 251 (2nd ed. 2005); Carl Christol, *supra* at 3 at 346, 365.

64 Ian Brownlie, *State Responsibility*, 45 (2001). *See* also Article 32 of Vienna Convention at *supra* note 40.

65 Horst Blomeyer-Bartenstein, *Due Diligence*, 10 ENCYCLOPEDIA OF PUBLIC INTERNATIONAL LAW 138, 141 (R. Dolzer et al. eds., 1981).

66 Martha Mejia-Kaiser, *Collision Course: 2009 Iridium Cosmos Crash*, 52 I.I.S.L. PROC.3.9, 4 (2009).

67 Riccardo Pisillo-Mazzeschi, *Due Diligence Rule and the Nature of International Responsibility of States*, STATE RESPONSIBILITY IN INTERNATIONAL LAW 113, 136 (Rene Provost ed., 2001); John Kelson, *State Responsibility for Abnormally Dangerous Activities*, 13 HARV. INT"L. L. J. 197, 238 (1972).

Outer Space Treaty[68] in fact expressly dictates that a State retains jurisdiction over space objects in outer space and thus responsible for any damages caused due to it. Subsidiarily, as laid down in Article IX of the Outer Space Treaty[69], that if there is a threat posed to another threat due its own space object, the State party is under an obligation to under consultation. The launching State would be liable for the compensable harm if it fails to avoid the collision of space object with the Claimant State and laggards in fulfilling the space norms. Additionally, the *Chorzow Factory*[70] opinion confirmed that international tort law is for the purpose of returning the Claimant State to a position it had been in the past had it not experienced the harm.

The duty of the launching State operator is not limited to the awareness[71] of the risk of harm but extends to whether the operator under circumstances should have been aware of the risk.[72]

Thus, if a space object of sovereign were to collide with that of another State, the liability imputed would be fault-based governed by standard of duty of care and due diligence. The standard is further demarcated by four recognised space norms which ascertain the responsibility of every launching State; non fulfilment of which would amount to liability. Where no fault can be determined *fortiori*,

---

68 *Supra* at 14.

69 *Supra* at 14.

70 Factory at Chorzow (Germ. v. Pol.), 1927 P.C.I.J. (ser. A) No. 9 (July 26).

71 Kathy Jones, Krista Fuentes & David Wright, A Minefield in Earth Orbit: How Space Debris Is Spinning Out of Control [Interactive], SCI. AM. (Feb. 1, 2012), http://www.scientificamerican.com/ article.cfm?id=how-space-debris-spinning-out-of-control. The article observes that tracking the space objects and space debris can avoid collisions by manoeuvring the space object or provide information to the State in route of harm. NASA had manoeuvred its space objects several times to avoid such collisions.

72 Rep. of the Int'l Law Comm'n, 53rd session, April 1-June 1, July 2-August 10, 2001, 151 U.N.Doc. (A/56/10); GAOR, 56th Sess., Supp No. 10 (2001).

neither of the damaged State parties would have recourse against each other. Regardless, any damage caused on the surface of the Earth as a consequence of this collision or the impact of the space objects or components thereof, would be assessed notwithstanding fault (absolute liability).

Application of Space Tort

As the initial point, it is helpful to identify the kinds of events that may give rise to space-related liability. Therefore, we should first formulate the definition of a space tort. Space has been defined as a location which is 100-110 km above sea level.[73] It has also been defined as a point in time-at the moment the final hatch to a space vehicle is closed.[74] The exact moment or place when an event will be considered to have occurred in space for purposes of applying space-specific remedies is likely to evolve on a case-to-case basis. An artificial location boundary, such as 100 km above the earth's surface, is not likely to prove to be practical in all cases, just as the marine league boundary applicable to the Death on the High Seas Act (DOHSA) has not proved practical, or in some cases, rational.[75]

Whether an incident causing damage, injury, or death should be considered a space tort will depend on a lot of factors, including the status of the parties, the nature of the operation, the location of the

---

[73] This location was proposed by the USSR at the 1978 COPUOS meeting of the United Nations and rejected by the United States.

[74] FED. R. CRIM. P 18, § 7, Special Maritime and Territorial Jurisdiction of the United States, Definition of Space, was amended Sept. 21, 1981 to include, "any vehicle used or designed for flight or navigation in space" and applies "while that vehicle is in flight, which is from the moment when all external doors are closed on earth."

[75] Where a death occurred within three miles of shore, the Supreme Court has held that the decedent's dependents may recover for loss of society under a maritime wrongful death remedy. Sea-Land Servs. Inc. v. Gaudet, 414 U.S. 873 (1974). No loss of society however, was allowed under DOHSA for a death occurring beyond the three-mile mark. Mobil Oil Corp. v. Higginbotham, 486 U.S. 618 (1977).

tort, and the time when it occurs. Thus, space law may ultimately be applied to events occurring on the launch pad prior to launch; inside and outside the space vehicle; and up until and including the moment of landing or collision with the earth. Future earth-based recovery or salvage efforts may possibly even fall within the scope of a space-relatedness definition.[76] Damage or injuries resulting from a space tort may also be varied. Specifically, the damage or injuries may be incurred by the space vehicle, its payload, its occupants, another space vehicle in a collision, or by people or property on the ground. The damage resulting from a space tort may be occasioned by the same range of duty breaches that occur here on earth, such as intentional conduct, gross recklessness, negligence, strict liability, or simply by the ultra-hazardous nature of the product or operation involved.

Current State of the Law with Regard to Space Torts

Given the rapid development of space-related projects, a wide range of incidents will inevitably result in space-related damages, injuries or death. Yet, at present, no treaty, statute, or case decision provides space-specific standards of conduct for a space tort. The international treaties into which the United States has entered create only a national as opposed to a private liability in the event of damage, injury, or death resulting in connection with a space mission.[77]

This treaty fails to address the myriad of damage scenarios where loss is occasioned other than by the collision of a space vehicle. For

[76] See Agreement on the Rescue and Return of Astronauts and the Return of Objects Launched in Outer Space, Apr. 22, 1968, 19 U.S.T. 7570, T.I.A.S. No. 6599, 672 U.N.T.S. 119, 7 I.L.M. 151 (1968)

[77] See Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, and T.I.A.S. No. 7762.

example, the West star and Palapa satellite losses, the Challenger accident has not been covered by this treaty.

At present times, the major regulating force with respect to potential space liabilities is the inclusion of risk-allocation provisions in contracts entered into by participants in space ventures. These contractual clauses, which typically require the purchaser of space hardware to waive all rights of liability against the manufacturer, have for years created a sense of security amongst insurers.

The contracts typically contain a complete risk allocation scheme for potential liability resulting from a space collision.[78] The risk-allocation clauses that presently exist in manufacturing contracts have been developed as a result of the broad inter-party waiver language contained in the NASA Launch Service Agreement.

Conclusion

It is obvious that notwithstanding the exhaustiveness, or lack thereof of the treaties, the subject is complex and convoluted. Wherefore, thus far, no actual loss of life, liberty or property in space exploration or activity cognizable under the treaties and agreements have been presented. It is only when issues in relation to liability have been addressed and resolved can there be a progress in outer space activities and its consequences can be assessed. *A priori* determination therefore is necessary. The paper entailed addressing the liability through tenets established under the liability convention and the less conventional route, space torts and reasons as to why

[78] . Although the focus of this article is the space tort, it must be recognized that a significant body of space law will be devoted, as in admiralty, to interpreting the standard clauses in space-specific contracts and space-specific insurance policies as disputes arise as to the meaning of indemnity, waiver, and subrogation provisions. As in admiralty, once these contracted provisions are tested and interpreted, the industry will probably see continued use of these same provisions since it is unlikely corporations will want to risk modified, untested language.

collisions could occur and duty flowing from such collision. Statements from eminent figures like erstwhile Secretary of State, Hilary Clinton in January 2012 to conduct a dialogue with the European Union to map out policies and rules to limit the debris collection is a leap towards progress and a safe space.[79] New tracking and tagging technology and mandatory duties to keep outer space hazard free could decrease probability of any such hypothetical scenario envisioned in the paper. Such development of technology with a collaborative effort of both policymakers and scientists will would eventually resolve the identification problems and more attention could be paid to liabilities flowing from "fault"; where concepts like statutory negligence and nuisance, malfunction liability and breach of custom and duties are developed. Preservation of space must be the absolute priority.

[79] John Heilprin, Swiss Craft Janitor Satellites to Grab Space Junk, YAHOO! NEWS (Feb. 15, 2012), http://news.yahoo.com/swiss-craft-janitor-satellites-grab-space-junk-113516830.html.

AVIATION LAW IS A PLAN OF LIFE

Mohini Goyal

Aviation has been subject to general law, both international and domestic law, since its inception. On 13 April 1784, the Paris police forbade flights of balloons without special permission, the very first trace of aviation law in history. There is a strong international character in the 100-year old history of space law, where a major part of air law is either international law or international uniform law. For more than 20 years, Space Law was a concept without form or substance and it was first stated in a journal published in Paris in 1910. The basics of private air law have been derived from the Roman law. Likewise the origin of governmental regulations of aeronautical activities goes back to the era of balloon flight.

Air law and space law are separate and distinct branches of law, although they are often regarded as one—aerospace law. Air law, the older of the two, is an agency regulated by national and international law, public and private law, which governs aeronautical activities and other uses of airspace. On the other hand, space law controls the outer space operations of states and private organisations, mainly the use of satellites.

Because the majority of air travel takes place globally, a range of legal principles have been established internationally covering the technical aspects of air navigation and are enforced by national legislation. Under the Convention on International Civil Aviation, of which 184 States are members, the International Civil Aviation Organization (ICAO), headquartered in Montréal, was set up. Hundreds of bilateral agreements, along with the multilateral International Air Services Transit Agreement of 1944 and some

terms of the Chicago Convention, primarily control the exchange of commercial rights in international air transport.

The need for national space legislation is crucial, especially as India is increasingly seeking to privatise and commercialise space assets, to expand its space exploration and scientific exploitation capabilities, to commercialise its satellite building capabilities, and to offer launch services from its facilities. In order to establish simple and open, accountable regulatory guidelines for domestic industries in order to speed up investment and ensure growth and development in this capital-intensive high return and highly regulated strategic market, the national space law should have been legislated in view of this emerging trend.

In India, space science activity dates back to the late 1940s. Two individual scientists, Homi Bhabha and Vikram Sarabhai, spurred this beginning. They shared several characteristics and accomplishments: both gained these through researchers who at an early age studied cosmic rays. Moreover, with great foresight, both were visionaries. They were founding members of a fundamental research institute. In 1954, Bhabha established the Tata Institute for Fundamental Research in Bombay, while the Ahmedabad Physical Research Laboratory was the result of the efforts of Sarabhai in 1947.

The Constitution of India articulates the starting point for a debate on the ideology that governs India in the conduct of foreign relations and in the meticulous exercise of international obligations. Article 51 of the Constitution directs the executive to foster world peace as an international aim for India and provides the basis for the domestic enforcement of the obligations of the international treaty. In addition to Article 51, under Articles 253 and 53, two other articles in the

Indian Constitution have a strong impact on the law-making process in India.

The Government of India is therefore qualified to give effect to the obligations of the international treaty by exercising, explicitly or indirectly, the executive power of the President of India pursuant to Article 53, without invoking the power of the legislature pursuant to Article 253 to fulfil the mandate of Article 51. This is actually the principle guiding state practise with regard to international commitments arising out of the four international outer space treaties12 ratified by India.

India has already set a precedent for the enforcement of international treaties bearing financial consequences. A good example is the Warsaw Convention 192923, which defines responsibility for harm incurred in the course of international civil aviation. Parliament enacted the Carriage by Air Act 1972 as a consequence of ratification of the Warsaw Convention as amended by the Hague Protocol 1955, allowing public sector airlines operating international routes to discharge liability to give effect to the responsibility of the treaty.

As regards air navigation, India recently introduced the Civil Aviation Authority of India Bill, 2013, which provides for the establishment of a Civil Aviation Authority for civil aviation safety administration and regulation, better management of civil aviation safety oversight of air transport service operators, air navigation service operators and other civil aviation facility operators.

India has enacted the Tokyo Convention Act 197531 with respect to aircraft hijacking to enforce the 1963 Convention on Offences and any other actions performed on board aircraft. On the other hand,

the Anti-Hijacking Act 198232 drew attention to the 1973 Hague Convention for the Suppression of Illegal Capture of Aircraft. The 1971 Montreal Convention for the Suppression of Unlawful Actions Against the Protection of Civil Aviation Act 198233 gave effect to the 1971 Montreal Convention for the Suppression of Unlawful Acts Against the Safety of Civil Aviation and the 1988 Montreal Protocol for the Suppression of Unlawful Acts of Violence at International Civil Aviation Airports.

Aviation law is considered a matter of international law due to the nature of air as a mode of travel. At the international level, the International Civil Aviation Organization (ICAO) provides the general rules and mediates international concerns regarding aviation. The ICAO is a specialized agency of the United Nations (UN). International law has emerged over decades and more or less within a coherent set of legal traditions and expectations. Together, these elements have brought a body of law into being. The current United Nations space treaties were adopted within a period of decade and a half. In considering them, the UN Resolution on Nuclear Power Sources of 1992 can also be noted, since it interacts with responsibility and the use of space, although it also figures in relation to the Space environment. Space activities are risky, subject to possible catastrophic failures.

First significant step to know Liability under public international law, is to understand liability under national law. Significantly, State liability under administrative law could, in turn, be divided into two parts: (a) liability for acts of privatized service providers for whose acts and responsibilities, instrumentalities of the State are liable; and (b) liability relating to air aviation services for which the State faces responsibility.

In response to the space science development, various organisations were created relating to Air and Space Law for evolving common principles for regulation of civil aviation and space activities. These were as under

(i) International Astronautical Federation (IAF) in 1950;

(ii) International Academy of Astronautics (IAA) in 1960;

(iii) International Institute of Space Law (IISL);

(iv) the earliest to all, International Law Association in 1873 at Brussels.

We have several bilateral and multilateral treaties and declarations to date, and some conventions either reinforce or change the International Air Public Law. Bilateral and multi-lateral treaties and declarations and some protocols concerning the peaceful use of outer space are in effect. From where outer space starts, there is no simple demarcation. As regards liability, the internationally agreed definition of liability assessment and even the manner and entity set up to claim compensation are not resolved. Claims must be resolved between the states impacted by damage and losses.

It is important to note that liability under space law is tortuous and hence compensation is to be given for damage or loss incurred due to accident of launched space object. In this regard the five space treaties have imposed duties on the launching state to pay compensation. The duties as to compensation for loss or responsibility under both OST and, where relevant, the Liability Convention, devolve as a matter of international law on the launching State. However, in case of aircraft hijacking there is criminal liability and punishment is to be provided according to state

law enacted by the members state to implement international space treaties.

As, international Law does not provide immediate and effective measures to protect territorial air space and to cease the violation of aerial sovereignty. The five freedoms of the air come under the ambit of basic rules of international law, but they cannot be considered to be absolute, unrestricted and inviolable. So, some suggestions are as following:

- First and foremost, concrete steps to clearly demarcate airspace and outer space should be undertaken by the United Nations.
- Disputes arising from the application of international and local legislation in the area of air and space should be resolved by arbitration or by the International Court of Justice.
- The international hijacking conventions must be strictly enforced, in particular the Montreal Convention, 1999 and the Beijing Convention and Protocol, 2011.
- The hijacking should be carried out under the authority of an international criminal court.
- The liability for damage caused by space objects to other countries is stated under Indian Space Policy, but neither any cap is prescribed nor any formula has been suggested to determine the amount of liability. The States concerned must have a bilateral discussion of the matter and arrive at an amicable resolution. It is therefore proposed that India enact a law to define the measure of obligation and the procedure for dealing with such cases.

CENTRE FOR AEROSPACE AND DEFENCE LAWS (CADL), NALSAR UNIVERSITY OF LAW, HYDERABAD

Justice City, Shameerpet, Medchal Dist., Hyderabad, Telangana, India– 500101
Phone: +91-40-23498404 / 402 / 446 Fax: +91-40-23498403
Web: www.cadl.nalsar.ac.in; www.dde.nalsar.ac.in; www.nalsarpro.org;
E-mail: cadladmissions@nalsar.ac.in

"*Aerospace, Defence and Maritime Education at the door steps of the needy with affordable cost*"

NALSAR University of Law established by Act 34 of 1998 is engaged in teaching and research in law and allied disciplines. In recognition of its academic standards National Assessment and Accreditation Council (NAAC) awarded it 'A' grade (A+ as per new grading system) with a score of 3.60 out of 4.00 which is the highest amongst all National Law Universities in the country. NALSAR has also been accorded with the status of Category-I under UGC (Categorization of Universities (only) for Grant of Graded Autonomy) Regulations, 2018.

NALSAR established the Centre for Aerospace and Defence Laws (CADL) in 2005 with the objective of promotion of teaching and development of Aviation, Space, Maritime, Telecom and Defence Laws and Regulations. Since then, NALSAR-CADL has been promoting the study of Aerospace and Defence Laws by introducing courses, conducting National and International Conferences, Moot Courts, Workshops and also publishing Newsletters, Journals, Books and Articles, besides awarding a few M.Phils. and Ph.Ds. in the said areas.

NALSAR through CADL offers the following courses:

1. Two-year M.A. in Aviation Law and Air Transport Management
2. Two-year M.A. in Security and Defence Laws
3. Two-year M.A. in Space and Telecommunication Laws
4. Two-year M.A. in Maritime Laws
5. One-Year Advanced Diploma in Aviation Law and Air Transport Management
6. One-Year Advanced Diploma in Maritime Laws
7. One-Year Advanced Diploma in GIS and Remote Sensing Laws

Eligibility for M.A. Programmes:

- Bachelor's Degree or an equivalent Degree in any discipline from any recognized University; or
- 3-year Degree/Diploma in Aircraft Maintenance Engineering (AME)*
- Candidates appearing for the final year examination of Graduation / Engineering are also eligible to apply.

*Applicable only for the M.A. in Aviation Law & Air Transport Management

Eligibility for Advanced Diploma Programmes:

- Bachelor's Degree or an equivalent Degree in any discipline from any recognized University; or
- 3-year Degree/Diploma in Aircraft Maintenance Engineering (AME)*
- Candidates who complete three years of their 5-year integrated LLB Degree programme in Law are also eligible to apply; or
- Candidates appearing for the final year examination of Graduation/ Engineering are also eligible to apply.

*Applicable only for the Advanced Diploma in Aviation Law & Air Transport Management

Admission Procedure:

Direct Admission subject to fulfillment of the eligibility criteria for the said Programme.

Important Dates:

Admission notification for the year 2022-23 will be released in March (Tentatively).

For further details visit: www.cadl.nalsar.ac.in or www.nalsarpro.org or www.nalsar.ac.in

Sd/-

Prof. V. Balakista Reddy
Registrar and Director,
Centre for Aerospace and Defence Laws (CADL),
NALSAR University of Law, Hyderabad

Centre for Aerospace and Defence Laws (CADL)
NALSAR University of Law
Justice City, Shameerpet, Medchal District, Telangana - 500101. India
Ph. No. 040 23498212, E-mail : cadladmissions@nalsar.ac.in