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Towards legal certainty for encouraging passenger liability insurance for private orbital and suborbital carriage

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ABSTRACT

Private orbital and suborbital flights are no longer sci-fiction. Once the space tourism industry takes-off, carriers will not be free from liability exposure and economic loss for damage sustained by space tourists. Therefore, insurance coverage, and risk management, as practical solutions to liability exposure, are essential for the successful and sustained development of the fledgling space tourism industry. Firstly, this research paper addresses the need for insurance for space tourism and the concerns of the insurance industry regarding lack of legal certainty governing carrier liability in space tourism. Secondly, the liability exposure of private orbital and suborbital carriers is analyzed under relevant international and national law. Thirdly, the paper looks at how international and national law may further the emergence of passenger liability insurance. Finally, the paper concludes that for the space tourism industry to thrive, it is necessary to establish clear liability and safety rules that consider the differences between orbital and suborbital flights. Simultaneously, this paper makes recommendations in this regard as these rules will create the necessary framework for orbital and suborbital passenger liability insurance to emerge.

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ACRONYMS AND ABBREVIATIONS

CSLA	Commercial Space Launch Act
FAA	Federal Aviation Administration
ICAO	International Civil Aviation Organization
ISS	International Space Station
LC	Convention on International Liability for Damage Caused by Space Objects (Liability Convention)
MA	Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement)
NASA	National Aeronautics and Space Administration
OST	Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty)
PAI	Personal Accident Insurance
POSC	Private Orbital or Suborbital Carrier
RC	Convention on Registration of Objects Launched into Outer Space (Registration Convention)
RRA	Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (Rescue and Return Agreement)
SARPs	Standards and Recommended Practices
SFP	Space Flight Participant
TPL	Third-Party Liability

INTRODUCTION

A. Introduction to the research question

Does current legislation provide enough legal certainty for the emergence of passenger liability insurance of private orbital and suborbital carriage? If not, what legal framework is missing to achieve the necessary legal certainty? When space tourism activities are made available to the general public, [1] it will be essential to ensure that there is appropriate insurance coverage as a means to transfer the risk of economic loss due to carrier liability for damage sustained by the passenger.[2] Academics, the space tourism and the insurance industries all agree that "[i]nsurance is key to the development of the space tourism industry because it will provide financial stability (e.g., confidence to investors and clients, lower prices and increased capacity). "[3] However, the insurance industry can only thrive if the insurable risk is defined and clearly established by law. Insurers for space tourism industry thus will only offer coverage if the international and national laws regarding liability for space tourism are clearly defined, which is not the case at the moment. Hence, this paper makes a case for bringing certainty regarding law of passenger liability for space tourism as this will be an important factor for the insurance industry for space tourism to prosper.

[1] Space tourism is already a reality, though at the moment it is an expensive mode of transport/ tourism. However, space industry is aiming towards and making efforts to make space tourism affordable. See Elizabeth Culliford, "Virgin Galactic's first test passenger gets commercial astronaut wings" (9 April 2019), online: *Reuters* < www.reuters.com/article/us-space-exploration-wings/virgin-galactics-first-test-passenger-gets-commercial-astronaut-wings-idUSKCN1RL2SO>; Eric M Johnson, "Exclusive: Jeff Bezos plans to charge at least $200,000 for space rides – sources" (2018), online: *Reuters* <www.reuters.com/article/us-space-blueorigin-exclusive/exclusive-jeff-bezos-plans-to-charge-at-least-200000-for-space-rides-sources-idUSKBN1K301R>.

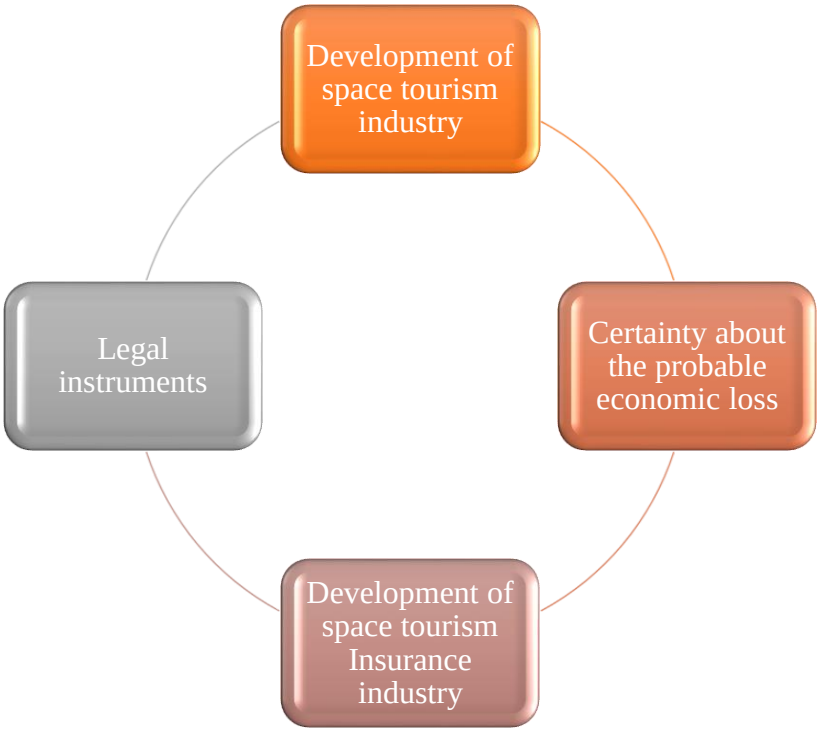
[2] See Steven Freeland, "Up, Up and ... Back: The Emergence of Space Tourism and its Impact on the International Law of Outer Space" (2005) 6:4 Chicago J Intl L 1 at 18.

[3] See e.g. Ana Cristina van Oijhuizen Galhego Rosa, "Aviation or space policy: New challenges for the insurance sector to private human access to space" (2013) 92:2 Acta Astronautica 235; Bill Behan, CEO of AirSure Ltd cited in Katie Dwyer, "Forging into the Final Frontier" (1 May 2014), online: *Risk & insurance* <riskandinsurance.com/forging-final-frontier/> ("The financing, investment, stability and future of the commercial space industry will depend on a strong and enduring partnership with the insurance industry").

Legal uncertainty as to the applicable law and the carrier's liability exposure is a deterrent for the insurance companies to offer passenger liability insurance for space tourism. "Traditional space activities are today well known and handled in terms of risk management and insurance, but some new activities may impact the standard insurances, [and question] the insurance obligations that may stream down."[4] Only by clarifying the legal playing field and the liability risks faced by the carriers can insurance companies develop adequate products to mitigate those risks. Needless to say, insurance and legal certainty as to the probable economic loss are interdependent. With legal certainty of the subject matter insured, insurance industry develops, and existence of insurance in a subject matter acts as a stabilizing factor for the subject matter of insurance and law regarding it.

With the aim of contributing to the emergence of passenger liability insurance, this study explores the existing laws on Private Orbital and Suborbital Carrier's (POSC) liability arising from death or injury to its passengers and proposes the adoption of clear regulations for the space tourism industry. This paper will propose that not just one, but an interplay of multiple legal instruments should be considered to procure the growth of the nascent industry. As a way of mitigating liability risk of space tourism carriers, insurance cannot stand by itself and, thus, it needs the support of the classic solutions, namely, (a) National Law, (b) International Conventions and (c) Soft Law, which should be developed to create an ideal legal environment in which space tourism insurance can thrive.

[4] Cecile Gaubert, "Insurance in the context of space activities" in Frans von der Dunk & Fabio Tronchetti, eds, *Handbook of space law*, (Cheltenham: Edward Elgar, 2015) 910 at 944.



B. Background to the research question

> "What might now be viewed as adventure or sport for the barnstormer and the risk-taker is what leads to yet one more giant step for mankind."[5]

"The advent of greater access to space, […] is going to happen much sooner than we think".[6] On 21 June 2004, the world witnessed the first *private*[7] human-crewed suborbital flight. Spaceship One, competing for the Ansari X Prize, went above the *Karman line*[8] while carrying the pilot and the weight equivalent to two passengers; Scaled Composites repeated this feat twice in that same year[9]. These accomplishments led to the creation of Virgin Galactic, "the Spaceline for

[5] "Commercial Space Transportation Beyond the X Prize: Hearing Before the Subcomm. on Aviation of the H. Comm. on Transportation & Infrastructure", 109th Cong (2005) at 10 cited in Rebekah Davis Reed, "Ad Astra Per Aspera: Shaping a Liability Regime for the Future of Space Tourism" (2009) 46 Hous L Rev 585.
[6] *ibid.*
[7] For the definition of "private," see "E. Limitation" at 14, below.
[8] See 2.2.2. at 30 below.
[9] Laurence E Gesell & Paul Stephen Dempsey, *Air Transportation: Foundations for the 21st Century* (Chandler: Coast Aire, 2010) at 159.

Earth,"[10]the current leader in manned suborbital flight with "a customer backlog of more than 600 people, more than $80 million in collected deposits already."[11]Six years later, on 8 December 2010, fully private endeavors to Outer Space became feasible when the SpaceX's Dragon capsule was launched and recovered after orbiting the Earth.[12] These two events are the milestones that marked the beginning of private suborbital and orbital carriage, respectively. The trip of Dennis Tito, the first orbital tourist, to the ISS onboard a Soyuz[13] in 2001 is not regarded in this research as a *private* space tourism feat since the vehicle was government-owned; it however, opened the possibility for the development of the space tourism industry.

Both orbital and suborbital private passenger carriage are part of what is commonly called "space tourism"; yet, this umbrella term is "not only imprecise but also confusing"[14] since the two types of flights may have different purposes, have different technical characteristics, and different destinations, and potentially different legal regimes. It must be kept in mind that referring to the activity of travelling beyond air space and earth orbit as "space tourism" can be confusing as ordinarily speaking, the word "tourism" is commonly associated with "visiting for pleasure."[15] However, legally speaking, "tourism" includes "traveling […] for […] business and other purposes."[16] Indeed, "in aviation for legal purposes, no difference is made between tourist

[10] "Who we are", online: *Virgin Galactic* <https://www.virgingalactic.com/>.
[11] Michael Sheetz, "New Virgin Galactic Chairman Chamath Palihapitiya says tourism spaceflights to begin within a year" (9 July 2019) online: *CNBC* <www.cnbc.com/2019/07/09/virgin-galactic-says-space-tourism-flights-to-begin-in-a-year-company-will-be-profitable-in-2021.html>.
[12] Steven Siceloff, "NASA - SpaceX Launches Success with Falcon 9/Dragon Flight" (9 December 2010) online: *NASA* <https://www.nasa.gov/offices/c3po/home/spacexfeature.html>.
[13] Mike Wall, "First Space Tourist: How a U.S. Millionaire Bought a Ticket to Orbit" (27 April 2011) online: *Space* <www.space.com/11492-space-tourism-pioneer-dennis-tito.html>.
[14] Frans von der Dunk, "Legal Aspects of Private Manned Spaceflight" in von der Dunk & Tronchetti, *supra* note 4, 662 at 666.
[15] OED Online, *Oxford University Press, (*2019) sub verbo "tourism, n", online: OED < www.oed.com/view/Entry/203936>.
[16] Statistical Office of the European Communities & United Nations, eds. *Tourism satellite account: recommended methodological framework* (Luxembourg: Commission of the European Communities, Eurostat; United Nations, Statistics Division, 2001) at 1.

passengers and business passengers on board the same aircraft."[17] The technical differences between achieving a suborbital flight versus an orbital flight, are "like building something to cross the English Channel and one to cross the Atlantic. "[18] "Because the speed needed to get into orbit is some eight times the velocity needed to reach sixty-two miles from Earth, the propulsive energy required for orbital flights is about sixty-four times of what is needed for suborbital flights."[19] Also, it can be contended that suborbital flights do not go into outer space. This paper will propose that suborbital flights should not be categorized as space flight as where outer space begins is not a settled issue as it has not reached consensus in the international setting. Thus, a phrase as insurance for "private orbital and suborbital flights" appears more adequate.[20] Lastly, the relationship between the space tourist and the suborbital/orbital carrier is not clear cut. Being called "space tourism," one would assume that this new industry is governed by space law and out of the scope of air law. However, with two different types of flights with different destinations and different technical characteristics, they could be governed by different legal regimes. In fact, as this paper will point out, when the question of governing the passenger liability and insurance of private orbital and suborbital flight arises, loopholes exist under both space law and air law.

Notwithstanding, "[t]he name is the hook that hangs the brand […] in the prospect's mind. […] A rose by any other name would not smell as sweet. Not only do you see what you want to

[17] Von der Dunk, *supra* note 14 at 667.
[18] Elon Musk, cited in Mike Tolson, "Private spaceflight gains momentum, profits" (10 October 2004), online: *Chron* < www.chron.com/news/houston-texas/article/Private-spaceflight-gains-momentum-profits-1964297.php>.
[19] Lewis D Solomon, *The Privatization of Space Exploration: Business, Technology, Law and Policy (New Brunswick: Transaction, 2008)* at 118. See also Caleb A Scharf, "Basic Rocket Science: Sub-Orbital Versus Orbital" (25 November 2015), online (blog): *Scientific American* <blogs.scientificamerican.com/life-unbounded/basic-rocket-science-sub-orbital-versus-orbital/>; Loren Grush, "Why you shouldn't compare Blue Origin's rocket landing to SpaceX" (24 November 2015), online: *the Verge* <www.theverge.com/2015/11/24/9793220/blue-origin-vs-spacex-rocket-landing-jeff-bezos-elon-musk>; Anel Ferreira-Snyman, "Legal Challenges Relating to the Commercial Use of Outer Space, with Specific Reference to Space Tourism" (2014) 17:1 Potchefstroom Elec LJ 1 at 6.
[20] See Frans von der Dunk, "Passing the Buck to Rogers: International Liability Issues in Private Spaceflight" (2007) Neb L, Faculty Publications 400 at 402,403.

see, but you also smell what you want to smell."[21] Certainly, the names "suborbital flight" and "orbital flight" do not sound as appealing as "space tourism"; the one that evokes "skipping our humble planet, to enter the greater cosmos […] to move beyond the tight constraints of life on earth and to break free from the chains of gravity."[22] Thus, in this paper I will use the term "space tourism", in alternative with "private orbital and suborbital flight," acknowledging the prevalence of the phrase "space tourism" in the media, the business, and even the academic setting.[23]

C. Theoretical Approach and Methodology

This research adopts a proactive approach concerning the regulation of private orbital and suborbital carriage. Specifically, it advocates for legal regimes in the international and national levels that bring legal certainty to insurers in order to dispel the concerns that the industry has expressed and that prevent it from developing insurance that can mitigate the liability that might be faced by orbital and suborbital carriers in the carriage of humans. From this approach, as "the public interest is served by creating a clear legal, regulatory, and safety regime for commercial human space flight."[24]not only the carriers will be the beneficiaries but all the stakeholders.

The study relies on doctrinal, comparative, and interdisciplinary analysis to arrive at the conclusions presented. The doctrinal analysis, used throughout this paper, identifies the law applicable to the two types of carriage studied and uncovers the loopholes in the relevant laws and regulations. The doctrine includes treaties, writings of highly qualified publicists, national laws, and regulations, with a relevant literature review to supplement the analysis. The doctrinal analysis, in conjunction with the comparative and interdisciplinary analysis, enables the inclusion of

[21] Al Ries & Jack Trout, *Positioning: The battle for your mind (New York: McGraw-Hill, 2001)* at 71.
[22] Konstantin Tsiolkovsky, 23 July 1935 cited in Jacqes Arnould, "Space Exploration: An Alliance Between Public and Private" in Jai Galliot, ed, *Commercial Space Exploration: Ethics, Policy and Governance* (Surrey: Ashgate, 2015) 61 at 68.
[23] See also Francis Lyall & Paul B Larsen, *Space Law - A Treatise (New York: Routledge, 2018).*
[24] 51 USC §50901 (a)(14) (2018).

elements from air law and physics in discussing and formulating a new proposal for the law applicable to suborbital flights in chapter 2.

D. Overview

Whereas this first section introduces the research question and the aim for legal certainty in order for the space tourism and space tourism insurance industries to develop, Chapter 1 exposes the current state of space tourism insurance and the insurance industry concerns holding back the development of a robust product that can mitigate carrier liability to passengers. Chapter 2 explores the liability in the private carriage of orbital and suborbital passengers, suggesting that neither space law nor air law are the current sources of carrier liability for orbital and suborbital flights. However, taking into account that orbital flights are launched "into Earth orbit or beyond"[25] and that suborbital flights go from one point on Earth to the same point or another point on Earth, it is argued that space law should regulate private orbital flights, while suborbital flights should be covered by air law Chapter 5 focuses on analyzing the advantages and disadvantages of national and international legal instruments that could make space tourism and particularly carriers' liability insurable. Finally, this paper presents conclusions and recommendations regarding orbital and suborbital carriers' liability exposure to passengers and the elements needed for these activities to be covered by the insurance industry. These issues are essential for the successful and sustained development of the space tourism industry, as "real concerns of liability, insurance coverage and risk management would have to be allayed before a sustained space tourism program takes to the heavens."[26]

[25] *Convention on Registration of Objects Launched into Outer Space*, 14 January 1975, 1023 UNTS 15 art II (entered into force 15 September 1976) [RC].
[26] Ruwantissa Abeyratne, *Space Security law*, (Heidelberg: Springer,2011) at 42.

E. Limitation

This study seeks to contribute to private space tourism insurance, particularly to mitigate carrier liability emanating from death or injury of the passenger, in an event where no other vehicle or flying/orbiting object is involved as the source of the damage. As for the legal character of the actors involved in the flight, this research is limited to orbital and suborbital human flights performed at the own expense of these actors or that of another private person or private entity and conducted by private entities. "Private" as opposed to "public" is understood in this paper as "non-governmental," "that is referring to persons or entities not formally part of the state's official bodies and usually, therefore, acting for personal motivations."[27]

CHAPTER 1: Space tourism insurance

1.1. Introduction

At the current stage of development, space tourism is considered to be "... at the stage when it is the preserve of visionaries and daredevils and adventurers...who will fly at their own risk [and]...who do not expect and should not expect to be protected by the government." [28] These affirmations made by a US congressman in 2018 do not differ much from what was stated ninety years ago by the French delegate in discussing the Warsaw Convention:

> If it were shown to me that the passengers by aircraft are unfortunates who have need of being protected much more than immigrants on the rail or on the ships, I would consent. But, you know, that at the present time those who travel by air have no need of a special protection; if they have need of protection, they will find it … in insurance![29]

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[27] Von der Dunk, *supra* note 14 at 666. See also, Kunihiko Tatsuzawa, "Policy and Law in Space Commercialization" in Kunihiko Tatsuzawa, ed, *Legal aspects of space commercialization* (Tokyo: CSP Japan, 1992) at 10.

[28] Rep. Rohrbacher testifying in the Congressional Record cited in US, FAA, *Study on Informed Consent for Space Flight Participants* (Doc APT-CFA-230-0001-02F) (Washington, 2008) [FAA, study], online: <www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/library/#hsf >

[29] Mr Ripert (France), Second International Conference on Private Aeronautical Law cited in George Leloudas, *Risk and Liability in Air Law (Informa, London 2009)* at 49.

With more than twenty-eight years of aviation history[30] and a death rate among passengers of one death in 9000 flights[31](0.011%) and in a year where only in the US 3,160,793 persons were carried in planes operated by airlines or taxis, the words of Mr. Ripert resonated well. However, in a time where the space tourism activity causes doubts as to the scope of liability to which the space entities are exposed and the risks are unclear, insurance may not be available, nor will it be affordable. Requiring space tourists to bear their risks and to obtain their own insurance at an early phase of the development of the industry is not feasible, especially due to the lack of technical and legal certainty which act as deterrent for the insurance industry to provide specific products. Further, ignoring the insurance industry concerns could be counterproductive for the growth of the space tourism industry which in turn requires legal certainty to obtain affordable insurance.

1.2. The state of space tourism insurance

The type of insurance and premium for space tourists vary widely depending on the surrounding facts and negotiations between the insurance company and the policyholder as evidenced in the following examples from orbital flights where public entities where involved.

Passenger liability insurance for space tourism has not yet been offered by the insurance industry. Space Adventures, the space tourism agency that has brokered the travels of eight tourists to the ISS on board the Russian State spacecraft Soyuz[32] purchased personal accident insurance (PAI)[33] for each of them. The tourists, if wanted or required, acquired additional life and health insurance. "Dennis Tito, the first space tourist, in 2001, was reported to have been issued life

[30] See Gesell & Dempsey, *supra* note 9 at 140 (The first airship flight was in 1901).
[31] Alexander Klemin, "Aviation in 1930" (1930) 143:6 Scientific American 462 at 488.
[32] The last flight to the ISS, which was brokered by Space Adventures, was the 2009 flight of Guy Laliberte. It is expected that two new orbital tourists fly in 2021. See Tariq Malik, "Russia Says It Will Launch 2 Tourists into Orbit for Space Adventures in 2021" (23 February 2019), online: *Space* <www.space.com/russia-launching-space-tourists-2021.html>.
[33] See Ana Cristina van Oijhuizen Galhego Rosa, *supra* note 3 ("Payment would occur in the event of passengers' death, injury or loss of limbs, resulting from accidents during a training or expedition period, including re-entry" at 240).

insurance by Russian insurer Avikos, in addition to other insurances he had obtained. Sheikh Muszaphar Shukor, a space tourist from Malaysia, had Marsh Insurance policy, paying a premium of US $1 million."[34] In a particular case, "Daisuke "Dice-K" Enomoto (who for health problems was not permitted to fly ultimately), […] was required to maintain life and health insurance sufficient to cover all losses connected with any bodily injury, severe injury, temporary or permanent loss of general ability to work, or any other injury [resulting from his participation in the spaceflight] . . . ."" [35].

Further, the coverage for the space tourist may be expected to be similar to those used in astronaut policies:

> - Personal accident benefits would be payable in the event the passenger dies or loses limbs or in case of an accident during the training or expedition period (including re-entry);
> - Provision of an indemnity for travel costs incurred due to the inability to go on a booked spaceflight as a result of accident or illness. The operative time of the coverage would include the training period plus the flight. In respect of the sum insured, the insurance market can currently provide standard capital insured from USD 2,000,000 up to USD5,000,000 but in no event exceeding five times the [space tourist's] annual salary.
>
> […] the issue of accumulation and limitation of capital insured aboard a single spaceflight will have to be addressed. Rates generally based on the capital insured, will also strongly reflect in the case of space tourism the valuation of the pure risk of spacecraft failure during pre-flight and flight phases. Standard exclusions would apply, including the pre-existing condition exclusion clause.[36]

Among the applicable exclusions, there are "suicide, alcohol, drugs, war, and terrorism;"[37]the latter two being coverable under certain conditions and with an additional premium.

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[34] *Ibid* at 237.
[35] Pamela L Meredith, "Commercial space transportation: liability and insurance", (Paper delivered at the International Conference on Air Transport, Air & Space Law Regulation, Abu Dhabi, India April 2009), online (pdf): <www.mcgill.ca/iasl/files/iasl/Session_7_Meredith.pdf> at 6.
[36] Denis Bensoussan, "Space tourism risks: A space insurance perspective" (2010) 66:11-12 Acta Astronautica 1633 at 1636.
[37] Gaubert, *supra* note 4 at 942.

Regarding specialized insurance for space tourism, at least four companies have announced their intention to offer space travel insurance. Eleven years ago, BUPA Travel announced its entry to the market, but a year later it expressed that "the actual travel opportunities are so niche at this point that premiums could be extremely high. Once the [space tourism] phenomenon is more mainstream, it will be much easier to assess how we would provide cover."[38] In 2011, in partnership with the International Space Travel Association, German insurance giant Allianz announced that it would start offering new space travel policies from the beginning of 2012[39]. The same year, Elseco Ltd. proclaimed that "orbital tourism will be a significant part of Elseco's business in the next decade."[40] However, nothing has been heard ever since. Three years later, Ironshore's Pembroke Managing Agency Limited, offered "cover for personal risk exposure of death, serious injury, and associated medical expenses for aspiring astronauts engaged in sub-orbital space flights."[41] The limited market and the uncertainties that come with space tourism have put the insurance solutions on standby.

"The insurance market is certainly up to the challenge [of serving the space tourism market] and the aviation, PA and space markets will no doubt vie for a piece of the action. But there is still a great deal of uncertainty, not only in the performance of commercial space flight operators but also in the status of the space tourist in terms of government regulations and international law."[42]

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[38] Stefan Mohammed, "One small step for insurers" (26 June 2009), online: *International Travel & Health Insurance J* <https://www.itij.com/feature/one-small-step-insurers>.

[39] "Allianz Global! Assistance and the International Space Transport Association (ISTA) partners in space tourism industry" (14 November 2011), online (pdf): *Allianz* <www.allianz.com/content/dam/onemarketing/azcom/Allianz_com/migration/media/press/document/other/press_release_partnership_allianz_global_assistance_and_ista.pdf>.

[40] Denise Schipani, "New frontier for insurance: Space travel" (21 December 2011), online: *insurance quotes* <https://www.insurancequotes.com/insurance-tips/space-travel-insurance>.

[41] Don Burgess, "Ironshore offers space travel insurance" (20 June 2014), online: *Bermuda sun* <bermudasun.bm/Content/BUSINESS/Business/Article/Ironshore-offers-space-travel-insurance/72/205/78489>.

[42] Simon Abbott, "Space Tourism: a new exposure", (2017) IIL London J 14.

1.3. Insurance industry concerns

1.3.1. Technical risks

As a consequence of the numerous risks that space tourism presents and "as a potential source of concerns of personal accident insurers due to possibility of mega exposure during 'VIP or high net worth flights' featuring millionaires and celebrities," [43] it is assumed by the industry that the first private flights will be "uninsurable and that premiums will remain very high until commercial spacecrafts produce 5 to 15 flights without accident. At this point only, the amount of data available to underwriters will allow an adequate assessment of the reliability of the vehicles and potentially lead to review the pricing." [44] Any event, involving death or injury of people, has a lasting impact on society, the industry and the insurance underwriter.[45] As with aviation, it can be expected extensive media coverage and a harmful and mistaken focus of the media on accident investigations as "a liability-allocating" exercise.[46] Thus, the future of the space tourism industry "will depend on its ability to continually improve its safety performance."[47]

While the available statistics for tests for future space tourism are scarce, it has been reported that in 2018 there were 114 orbital launches in total, 3 of which failed[48] (2.63%). In the same year, 15 suborbital flight vehicles were tested, 4 of them failed (26.6%).[49] On the other hand,

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[43] Bensoussan, *supra* note 36 at 1636.
[44] *Ibid* at 1638.
[45] See Robert A Goehlich, "Space Tourism: Hurdles and Hopes" (2014) 1:1 Intl J Aviation Systems, Operations & Training 17 at 30. See e.g. Nicky Woolf & Amanda Holpuch, "One pilot dead as Virgin Galactic's SpaceShipTwo rocket plane crashes", (1 November 2014), online: *The Guardian* <www.theguardian.com/science/2014/oct/31/spaceshiptwo-richard-branson-virgin-crash-mojave>; "Incident on SpaceX pad could delay its first manned flight" (21 April 2019), online: *Phys org* < phys.org/news/2019-04-incident-spacex-pad-flight.html>; Jeff Foust, "Faulty valve blamed for Crew Dragon test accident" (15 July 2019) online: *Space news* < spacenews.com/faulty-valve-blamed-for-crew-dragon-test-accident/>.
[46] See Leloudas, *supra* note 29 at 22.
[47] 51 USC §50901 (a)(12) (2018).
[48] This statistic includes private and public satellite launches. Ed Kyle, "Space Launch Report: Orbital Launch Summary by Year" (31 December 2018), online: *Space launch report* <www.spacelaunchreport.com/logyear.html>.
[49] Aeronautical Chamber of Commerce of America, *The Aircraft Year Book for 1930* (New York: D Van Nostrand, 1930) at 11.

the aviation industry counts with reliability statistics that show one accident for every 740,000 flights[50](0.0001%); figures that are not so different from what is expected from future suborbital flights where "the most common reliability figure targeted is one fatal accident expected for 50,000 flights"[51] (0.0002%). Even better, the International Association for Advancement of Space Safety (IAASS) considers that "a quantitative safety target of 1 accident per 10,000 flights (0.01%) may be achievable in current suborbital vehicle developments by using proven, well-understood and reliable rocket propulsion technologies, application of best safety practices from past and current government space projects, performance of wide ground and flight testing program, and rigorous quality control program."[52]

Normal airline service depends on successful flight rates not significantly different from one hundred percent success. If that rate is not achieved, the plane type is grounded for safety reasons. A moderately busy airport has the same number of flights daily without failures that of rocket launches in a year with several major failures. This deficiency must and can be overcome.[53] Indeed, it must be taken into account that aviation was also a novel and risky activity in the beginning and that the current statistics for aviation have been achieved after countless flights and "nearly twenty-five years before passenger service began to assume any significance."[54] Reliability is due partly to the legal certainty provided by the Warsaw Convention and other similar conventions that limited the liability of airlines. Certainty as for the compensation amounts to pay, helped the industry grow. Similarly, insurance will limit the amount spent by POSCs on liability

[50] See "IATA Releases 2018 Airline Safety Performance" (21 February 2019), online: *IATA* <www.iata.org/pressroom/pr/Pages/2019-02-21-01.aspx>.
[51] See Bensoussan, *supra* note 36 at 1637; Von der Dunk, *supra* note 20 at 407.
[52] Tommaso Sgobba, *"Commercial Human Spaceflight Safety"* (Presentation delivered at ICAO, Montreal, October 2013), online (pdf): ICAO <www.icao.int/airnavigation/AeroSPACE-Transport/Documents/Council%20Informal%20Briefings/21%20October%202013/2-IAASS.pdf>.
[53] See Roger Handberg, *The Future of the Space Industry: Private Enterprise and Public Policy* (Westport: Quorum Books, 1995) at 29.
[54] Gary Fromm, "Aviation Safety" (1968) 33 Law & Contemp Probs 590 at 590.

claims and the uncertainty of the compensation to be paid and thus, will help the space tourism industry grow.

Regarding safety regulations "intended to protect the health and safety of crew and space flight participants," [55] the U.S.A Congress decided to impose a "learning period" until 1 October 2023 where "the regulatory standards governing human space flight *must evolve as the industry matures* so that regulations neither stifle technology development nor expose crew or space flight participants to avoidable risks."[56] During that period, the "FAA, absent death, serious injury, or close call, [must abstain] from promulgating any regulations governing the design or operation of a launch vehicle". This prohibition is close to be over and the FAA already projects regulating occupant safety when the moratory expires[57].

The ideal stage of space tourism would be to be at the level of aviation today where "even without limits, the remarkable safety records of the aviation system guarantees that the number of multi-fatality accidents, which tend to have the most serious effect upon the capacity of insurers to provide compensation, will remain within the insurance policies' limits."[58]

1.3.2. Concerns due to lack of legal certainty for space tourism

At the international level, two main issues affect the determination of the scope of liability of the POSC: first, the delimitation of air space and outer space, which influences the applicable law, and in case that space law is applicable, the second issue is the special legal status, if any, of the space tourist.

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[55] US, *Report to Congress: FAA Evaluation of Commercial Human Space Flight Safety Frameworks and Key Industry Indicators* (Washington, DC:2017), online (pdf): <www.faa.gov/about/plans_reports/congress/media/CSLCA_Sec111_Report_to_Congress.pdf>.
[56] 51 USC 50901 (2018) [emphasis added]
[57] See US, FAA AST, *Commercial Space Transportation Overview* (23rd Mtg of the Cross Polar Trans-East Air Traffic Management Provider's Working Group (CPWG/23), Arlington, Virginia: 31 May 2017) at 8, online (pdf): *FAA* <www.faa.gov/about/office_org/headquarters_offices/ato/service_units/systemops/ato_intl/documents/cross_polar/CPWG23/CPWG23_Brf_Commercial_Space_Transportation_Intro.pdf>.
[58] Leloudas, *supra* note 29 at 88.

(a) Lack of delimitation of airspace and outer space

Though these are old debates, with suborbital flights becoming a reality, some have advocated for the urgent definition of a boundary to determine what legal regime should apply these flights: air law, space law or both[59]. The question is a matter of where or when sovereignty ends and where or when free use and exploration can be exercised.

Additionally, Article II of the Outer Space Treaty[60] 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."[61]. Therefore, contrary to air law, where the airspace above States is considered to be sovereign territory, outer space is not subject to territorial sovereignty.[62] In addition to the sovereignty implications, determining the applicable law would bring certainty on the sources and scope of carrier liability in suborbital space tourism as the air law and space law regimes differ. Although the definition and delimitation of a boundary between airspace and outer space is such an important issue, "no final conclusion has been reached yet"[63]on this matter.

[59] See 2.2.2, below for more on this topic.
[60] *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and other Celestial Bodies*, 27 January 1967, 610 UNTS (entered into force 10 October 1967) [OST].
[61] *Ibid* art II.
[62] See *Convention relating to the regulation of Aerial Navigation* (*with Additional Protocol)*, 13 October 1919, 11 LNTS 173 (entered into force 29 March 1922) [Paris Convention] ("[…]every Power has complete and exclusive sovereignty over the air space above its territory" art I); *Convention on International Civil Aviation*, 7 December 1944, 15 UNTS 295 (entered into force 4 April 1947) [Chicago Convention] ("[…] every State has complete and exclusive sovereignty over the airspace above its territory" art I). See also, Jan Klabbers, *International Law*, 2nd ed (Cambridge: Cambridge University Press, 2017) at 274.
[63]See ICAO Council, *Concept of Sub-orbital Flights*, ICAO 175th Sess, ICAO Doc C-WP/12436 (2005) [ICAO, suborbital flights].

(b) Uncertain legal status of space tourists

The second issue arises due to the use of the terms "astronauts" and "personnel of spacecraft," and the special status provided to them in the OST and the Rescue Agreement (RRA).[64] The expression "envoys of mankind"[65] which appears in the OST in relation to astronauts, seems more adequate for the government-sent representatives to conduct research and enhance the knowledge about space, and not for people that are going to Outer Space with a personal purpose.

The term 'space tourist' is not defined by Space Law and although the terms 'astronaut/cosmonaut' and 'personnel of a spacecraft' are mentioned in the space treaties, they are not defined anywhere in the said treaties. Article V of the OST refers to 'astronauts,' and the RRA is called "Agreement on the Rescue of *Astronauts*, the Return of *Astronauts* […]", a term that repeats in its preamble while mentioning 'personnel' in the subsequent articles. However, with the advent of space tourism, it has been questioned if these terms could include space tourists.

The term "personnel of a spacecraft" suggests that the person is part of the crew, that it is "employed in an organization, or engaged in a service or undertaking, esp. of a military nature; staff, employees collectively,"[66] characteristics that the space tourists do not possess. Additionally, the term indicates there is a relation with a "spacecraft," situation that would discard suborbital passengers from being considered "astronauts/cosmonauts" as per this research paper substantiates in Chapter 2, suborbital vehicles should not be considered "spacecraft/space object."

The absence of the term "space tourist" and lack of a clear definition of astronaut/cosmonaut and personnel of a spacecraft in Space Law has its origins in that by the time

[64] *Agreement on the Rescue of Astronauts and the Return of Objects Launched in Outer Space*, 22 April 1968, 672 UNTS 119 (entered into force 3 December 1958) [RRA].
[65] *Ibid*, art V.
[66] *OED Online, Oxford University Press,* (2019) sub verbo "personnel, n", online: *OED* <www.oed.com/view/Entry/141512>.

the five Space Treaties were concluded, the possibility of non-governmental persons going into outer space for a personal interest was perhaps not envisaged[67]. With the trip made by Dennis Tito in 2001, that situation drastically changed.

Rendering space tourists as astronauts would signify the obligation for the States, the private carriers, and even other tourists to render "all the necessary" assistance to a tourist in distress[68]. It has been proposed that following humanitarian considerations the RRA should apply to space tourists[69]. This proposal "may well backfire: why then any need to establish a special Agreement to provide for the – rather extended! – obligations of relevant States to come to the rescue, to 'immediately take all possible steps…and render … all necessary assistance'[70] without regard for costs or own safety?"[71] Requiring *all necessary* assistance instead of *all practicable* assistance[72] would create an additional burden to the States and private entities when space tourism becomes common.

In this context, the U.S.A. and the ISS have adopted the term "Space Flight Participant" (SFP) although with different definition.[73] SFP would be a new category different from those established by Space Law treaties, suggesting that SFPs should not be entitled to the label of

[67] See e.g. Freeland, *supra* note 2 at 10; Caley Albert, "Liability in International Law and the Ramifications on Commercial Space Launches and Space Tourism" (2014) 36:2 Loy LA Intl & Comp LJ 233 at 260; Carla Sharpe & Fabio Tronchetti, "Legal Aspects of Public Manned Spaceflight" in von der Dunk & Tronchetti, *supra* note 4 at 648.
[68] See Lyall & Larsen, *supra* note 23 at 117,118.
[69] See e.g. Mark J Sundahl, "The Duty to Rescue Space Tourists and Return Private Spacecraft" (2009) 35 J Space L 163; Yun Zhao "A Legal Regime for Space Tourism: Creating Legal Certainty in Outer Space" (2009) 74 J Air L & Com 959.
[70] RRA, *supra* note 65 art 2.
[71] Von der Dunk, *supra* note 14 at 711.
[72] See Chicago Convention, *supra* note 62 art 25.
[73] 14 CFR § 401.5 ("Space flight participant means an individual, who is not crew, carried aboard a launch vehicle or reentry vehicle"); *Multilateral Crew Operations Panel (MCOP)Agreement* of 2001 (Spaceflight participants are "individuals (e.g. commercial, scientific and other programmes; crewmembers of non-partner space agencies, engineers, scientists, teachers, journalists, filmmakers or tourists) sponsored by one or more partner(s). Normally this is a temporary assignment that is covered under a short-term contract" para III).

'envoys of mankind' established in the OST nor to the special treatment envisaged for astronauts/cosmonauts by the RRA.[74] However no public international law exists on the matter.

At the domestic level, the U.S.A. was the first State to regulate the commercial space activities conducted in its territory or by its citizens[75] and has to date, the most robust set of laws and regulations regarding "human space flight." However, it does not offer legal certainty as to the liability exposure of POSC. Neither the law nor the regulations require insurance nor provide government indemnification to protect the POSC from liability claims from the Space Flight Participants (the passengers). This situation leaves all the financial responsibility on the operator who, before a court under a tort claim, could face unlimited liability because no threshold is established by federal law or regulations Some U.S.A. States[76] have enacted legislation providing conditional immunity to private operators for claims on behalf of an SFP from maintaining an action or recovery for injury resulting from space flight activities. Nevertheless, these legislations do not give immunity if the operator commits an act or omission that constitutes "gross negligence evidencing willful or wanton disregard for the safety of the SFP, and that act, or omission proximately caused an SFP injury; or the entity intentionally causes an SFP injury." [77] As a result, the POSC will be exposed to be sued under tort. Moreover, although similar, the statutes have significant differences and could be deemed to be preempted by federal law. Thus, the various weaknesses of the law, regulations and statutes must be considered by the legislators, regulators and private parties to mitigate the liability exposure of POSC in the future and provide solutions

[74] See Frans von der Dunk, "International Space Law" in Von der Dunk & Tronchetti, *supra* note 4, 29 at 80.
[75] 14 CFR § 400.2.
[76] California, Colorado, Florida, New Mexico, Texas, and Virginia.
[77] Michael C Mineiro, "Assessing the Risks: Tort Liability and Risk Management in the Event of a Commercial Human Space Flight Vehicle Accident" (2009) 74 J Air L & Com 371 at 381.

such as legally mandated waivers, liability caps[78], and insurance[79], all of which will promote the emergence of more private commercial space flight operators.

1.4. Conclusion

The most common insurance used by space tourists that went to the ISS is PAI. This insurance permits rapid indemnification of the victim or its legal successors without seeking any liability of any potentially accountable person.[80] However, at the dawn of space tourism, the high profile of early space tourists can turn the risks uninsurable through PAI Insurance. On the other hand, insurance based on clear and limited liability, could emerge and boost the space tourism industry. Space travel insurance has been announced by several private entities, but the technical and legal uncertainties have prevented its spread as well as the emergence of passenger liability insurance.

Private space tourism is a novel industry that lacks data as no private flights have been performed carrying tourists. The underwriters will have to insure based on what operators present. In this context, demonstrating a high regard for passenger safety and reliability is the top priority.

In the early stages of the industry, the technical concerns of the insurers can be addressed by, using "proven, mature technologies and conservative heritage designs with lots of margins and redundancies; […] collection and analysis of relevant reliability and safety records; [as well as the vehicle's] capacity to prevent, mitigate and survive accidents and protect passenger safety in all circumstances." [81]

[78]See Zeldine Niamh O'Brien, "Liability for Injury, Loss or Damage to the Space Tourist" (2004) 47 Proc on L Outer Space 386 ("Limitations on liability have a number of benefits for industry. Steel observes that such limitations encourage investment, ensure a level playing field for all operators, provide comfort to the insurance industry and discourages punitive recovery" at 393).
[79] See Tatsuzawa, *supra* note 27 at 7.
[80] See Gaubert, *supra* note 4 at 942.
[81] Bensoussan, *supra* note 36 at 1638.

Regarding legal uncertainty, the insurance industry would appreciate "the prevention and limitation of the operator liability exposure to claims through the implementation of waivers, disclaimers, hold harmless agreements and the application of friendly law and jurisdiction in the spaceflight contract." [82] Thus, in order to contribute to making passenger liability insurable, it is crucial to identify the carrier sources of liability and how it could be mitigated. Convinced that legal uncertainty and the potential for multiple claims from a single incident can translate in financial and reputational damage of the space tourism industry,[83]effort is undertaken in this study to identify the applicable law and the recommendation to adopt international and national regulation that shield the fledgling industry.

CHAPTER 2: Liability in the private carriage of orbital and suborbital passengers

2.1. Introduction

Space tourism comprises two distinct types of flights, namely orbital and suborbital flights. Orbital flights go to Earth Orbit and beyond, while "suborbital" strictly speaking refers to the technical/operational feat of 'not completing one orbit' around the earth. ICAO has defined a suborbital flight as "a flight up to a very high altitude which does not involve sending the vehicle into orbit."[84]Further, the FAA defines "suborbital trajectory" as "the intentional flight path of a launch vehicle, reentry vehicle, or any portion thereof, whose vacuum instantaneous impact point does not leave the surface of the Earth."[85] Although it is clear that orbital flights would be governed by space law, the characteristics of said legal regime leave the relationship between carrier and passenger unregulated. As regards to suborbital flights, the legal regime that applies is not clear. While orbital tourism implies a clear intention to go into outer space and remain there for a period,

[82] *Ibid*.
[83] See Davis Reed, *supra* note 5 at 604.
[84] ICAO, suborbital flights, *supra* note 63 at 2.
[85] 51 USC § 50902(25) (2018).

suborbital tourism seeks to recreate the sensation of being in outer space without reaching it - or by reaching high altitudes considered by some as outer space - for a reduced amount of time.

2.2. Applicable law to private orbital and suborbital carriage of passengers

2.2.1. International space law and the relationship between carrier and passenger

The international space law system is fundamentally formed by the five Space treaties: The OST[86], the RRA,[87] the Liability Convention[88] (LC), the Registration Convention[89] (RC), and the Moon Agreement[90] (MA). At the time these space treaties were drafted, States were the sole actors in the space arena and although the participation of private entities as authorized and supervised by the "appropriate State" was envisaged, purely private relationships as the one between carrier and passenger were not expected.[91] Hence, private companies are not a direct subject of rights and duties arising from these space treaties. The rights and duties of private entities are subject to domestic space laws in conformity to the current international space law system[92]

Under Article VI of the OST, States undertake direct responsibility for the activities carried out by its non-governmental entities,[93] "for assuring that national activities are carried out in conformity with the provisions set forth in [the OST]" and to authorize and continuingly supervise those activities.

However, the international obligations emanating from Article VI of the OST should not be confused with those of Article VII of the same treaty. State responsibility is different from State

[86] OST, *supra* note 60.
[87] RRA, *supra* note 65.
[88] *Convention on International Liability for Damage Caused by Space Objects*, 29 March 1972, 961 UNTS 187 (entered into force 1 September 1972) [LC].
[89] RC, *supra* note 25.
[90] *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, 18 December 1979, 1363 UNTS 3 (entered into force 11 July 1984).
[91] See Ferreira-Snyman, *supra* note 19 at 6.
[92] See *Ibid*.
[93] See Bin Cheng, "Article VI of the 1967 Space Treaty Revisited" (1998) 26:1 J Space L 7 at 28.

liability. Responsibility is not limited to monetary compensation for damage and focuses on wrongful acts, while "international liability is premised upon the occurrence of significant harm or damage and not on any violation of an international obligation or subjective international right of a State."[94]

According to Article VII of the OST, each State that launches or procures the launching of an object into Outer Space, and each state from whose territory or facility an object is launched, is internationally liable for damage to another State or to its natural or juridical persons by such object or its component parts.[95] Articles II and III of the LC complemented State liability under Article VII of OST by providing for absolute liability for damage caused by a space object "on the surface of the earth or to aircraft in flight" and fault liability "in the event of damage being caused elsewhere than on the surface of the Earth".[96]

Due to the growing number of private space operators, States seek to limit or exclude their liability for the actions of the private entities.[97] States such as Russia, would establish a right of recourse against POSCs "when [the States] have paid compensation for damage pursuant to their liability under international law" [98]. In addition, some States such as the U.S.A.[99], UK[100], and Australia[101]would require the private companies to acquire insurance against third party liability and damage to government property – "at least up to the amount which is insurable on the market.

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[94] Sreenivasa Rao, Pemmaraju, Special Rapporteur, *Third report on international liability for injurious consequences arising out of acts not prohibited by international law (prevention of transboundary damage from hazardous activities)*, UNILCOR, 52nd Sess, UN Doc A/CN.4/510 (2000) at 121.
[95] See OST, *supra* note 60 art VII.
[96] See LC, *supra* note 88 arts II, III.
[97] See Ferreira-Snyman, *supra* note 19 at 36.
[98] Law of the Russian Federation on space activities, No. 5663-1, 20 August 1993, effective 6 October 1993, Arts. 17,30, online: <www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/russian_federation/decree_5663-1_E.html>. [Russian law]. See also, Irmgard Marboe, "National Space Law" in Von der dunk & Tronchetti, *supra* note 4 at 147.
[99] See 51 USC §§ 50914, 50915 (2018);14 CFR § 440.9 (2018).
[100] See United Kingdom Outer Space Act 1986, Sec. 5, para.2, Sec. 10
[101] See Government of Australia, Federal Register of Legislation, Space Activities Act No. 123 1998 [Australia SAA] Sec. 48, 74.

Compliance with national space laws is monitored by State organs, and violations are sanctioned by monetary fines […]."[102] Therefore, through domestic law, private companies can be subject to liability for damages caused by their space object on the surface of the Earth, to aircraft in flight, or elsewhere than on the surface of the Earth.

Under Article II and Article III of the LC, the damage must be "caused by a space object". This phrase is often understood as "physical collision of the space object with the damaged items."[103] Some authors claim that the damage covered by the LC also includes damage "without direct physical collision, such as by way of electronic or laser interference, [and] that indirect or consequential damage is also an inherent element of the liability compensable under the Convention; [however, those claims are] generally frowned upon."[104]

In order for the LC to apply in the context of space tourism, one must consider two different locations at which damage can be caused [105]: "on the surface of the Earth,"[106] and, "elsewhere than on the surface of the Earth."[107] In the first situation, a component part of the space object (vehicle) would have to cause "loss of life, personal injury or other impairment of health"[108] to a tourist by colliding with it on surface of the Earth or airspace, such as colliding with launchpad during launch or with an aircraft on land or in flight. Additionally, for the LC to apply, the tourist cannot be a national of the launching State nor a foreign national participating in the operation of the space object.[109] Even if all the mentioned conditions are present, the tourist's compensation for its

[102] Marboe, *supra* note 98 at 185.
[103] Von der Dunk, *supra* note 74 at 85.
[104] *Ibid*.
[105] As it was explained in the introduction to this paper, this research is limited to damage suffered by space tourists on board an orbital or suborbital vehicle, without the involvement of any other vehicle or object.
[106] LC, *supra* note 88, art II.
[107] *Ibid* art III.
[108] *Ibid* art I.
[109] *Ibid* art. VII.

damages would depend on its State of nationality to present a claim on its behalf against the launching State. Consequently, the possibility for an orbital carrier to indemnify its launching State for compensation paid to a tourist resulting from damage caused on Earth is remote[110]. Regarding damage caused by the space object "elsewhere than on the surface of the Earth"[111], Article III of the LC is clear in that said damage must be caused "to a space object *of one launching State* or to persons or property on board such a space object *by a space object of another launching State*."[112] Thus, damage caused to the tourists onboard the carrier's spacecraft that performs the orbital flight, by the same space object, is not covered by the LC.

2.2.2. Suborbital carriage: A case for air law

The dawn of private suborbital flights has revived the issue of delimitation of airspace and Outer Space. Despite delimitation of airspace and outer space has not been consensually agreed upon at international law, until now a functional approach is being used to determine the application of air law or space law. Under the functional approach, the application of any of said legal systems is defined by the vehicles used and their purpose. However, some of the vehicles have characteristics both of aircraft and spacecraft as well as the purpose to traverse both airspace and outer space. Suborbital vehicles have characteristics of aircraft as they "*can* derive support in the atmosphere from the reactions of the air"[113] and have characteristics of spacecraft as they are "capable of moving […] without any support from the air, [with] a power source not dependent upon external oxygen."[114]

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[110] See also Ferreira-Snyman, *supra* note 19 at 35.
[111] LC, *supra* note 88, art III.
[112] *Ibid.*
[113] ICAO, "Annex 7 to the Convention on International Civil Aviation, Aircraft Nationality and Registration Marks" (2012), online (pdf): ICAO <dgca.gov.in/intradgca/intra/icao%20annexes/an07_cons.pdf> at 1 [emphasis added].
[114] Ram S. Jakhu, Tommaso Sgobba & Paul Stephen Dempsey, *The Need for an Integrated Regulatory Regime for Aviation and Space: ICAO for Space?* (Wien, Germany: Springer Science & Business Media, 2011) at 60.

Currently, two approaches lead the discussion: "'spatialists' advocate that the choice of applicable law as regards activities above the earth's surface (air law or space law) should depend (…) on where any object finds itself, 'functionalists' by contrast advocate that space law should be applied to looking at the functions of a particular operation, […] presumably negating the need to establish a clear-cut boundary between airspace and outer space."[115]

Although no clear boundary has been established and the discussion seems to become more complex with the proposal of adding an intermediate zone between the air space and the outer space, 100km has become the figure that has received some support from States[116] like Kazakhstan[117], Australia[118], Nigeria[119], and Denmark[120]. The theory of aerodynamic lift, asserted by the Fédération Aéronautique Internationale (FAI)[121]appeared from the discussions revolving around the calculations of the eminent scientist Theodore von Karman, who pointed out that above a certain altitude "the Earth's atmosphere becomes too thin for aeronautical purposes (because any vehicle at this altitude would have to travel faster than orbital velocity in order to derive sufficient aerodynamic lift from the atmosphere to support itself)". [122]

Another rule that sustains the 100 km mark and is backed by COPUOS, is that this is the line dividing "non-orbital velocity" from "orbital velocity" and that this altitude is the lowest

[115] See e.g. Von der Dunk, *supra* note 74 at 87.; Gbenga Oduntan, "The Never Ending Dispute: Legal Theories on the Spatial Demarcation Boundary Plane between Airspace and Outer Space" (2003) 1:2 Hertfordshire LJ 64; Ferreira-Snyman, supra note 19 at 9.
[116] See Oduntan, *supra* note 115 at 69,70. See also René Oosterlinck, "Private Law Concepts in International Law" in Tatzuzawa, *supra* note 27 at 48. 51 USC § 20103 (1) (a).
[117] Law of the Republic of Kazakhstan on Space Activities, 6 January 2012, No. 528-4, Chapter 1, article 1 at 6. Online: < bayterek.kz/en/info/zakon%20o%20kosmose.php >.
[118] Australia SAA, *supra* note 101 Part. 2, at 8.
[119] Regulations on the Licensing and Supervision of Space Activities, 2015 draft, Sec. 43, 1st resp. para 6.
[120] Government of Denmark, Ministry of Higher Education and Science, Outer Space Act., cf. Act no. 409 (11 May 2016), Part 2, 4 at 4. Online*:* < https://ufm.dk/en/legislation/prevailing-laws-and-regulations/outer-space/outer-spaceact.
pdf >.
[121] FAI, "100km Altitude Boundary for Astronautics" (1 August 2017), online: *FAI* <https://www.fai.org/page/icare-boundary>.
[122] Theodore von Karman cited in Von der Dunk, *supra* note 74 at 65.

perigee a satellite can reach and that "only very rarely did satellites seem to 'dip' below an imaginary 100km altitude line."[123]

Although a clear division line between airspace and outer space can be useful for demarcating the extent of sovereignty over the territory of the States, it may not be the best approach for addressing the question of applicable legal regime for suborbital flights. To determine whether air law or space law should govern suborbital flights, more attention should be given to the status of the suborbital vehicle: is it an aircraft or a spacecraft?

Suborbital flights nowadays depart and re-enter in the same territory, but projects exist to develop flights to transport passengers from one point of the globe to another, and that would signify entering in foreign airspace. If the suborbital vehicle is considered a spacecraft, it would have the right of innocent passage as the freedom of passage of space objects through national airspace is considered customary law.[124] However, if considered an aircraft, according to rulings of the International Court of Justice, in virtue of the principle of respect for territorial sovereignty, every overflight must be authorized.[125]

International liability in air law and space law depends on whether the vehicle is a spacecraft or an aircraft. In the LC, the liability exists as long as there is a space object, and it is capable of causing damage.[126] As for air law, carrier liability applies to "international carriage […] performed by aircraft."[127]

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[123] *Ibid* at 68.

[124] See e.g. Manfred Lachs, *The Law of Outer Space: An Experience in Contemporary Lawmaking* (Leiden: Martinus Nijhoff,2010) at 60; Stephen Gorove, "Legal and Policy Issues of the Aerospace Plane" (1988) 16 J Space L 147 at 150.

[125] *Case Concerning Military and Paramilitary Activities in and against Nicaragua* (Nicaragua v United States), merits [1986] ICJ Rep 14 ("[t]he principle of respect for territorial sovereignty is also directly infringed by the unauthorized overflight of a State's territory by aircraft belonging to or under the control of the government of another State" at 128).

[126] Katarzyna Malinowska, *Space insurance: international legal aspects* (Alphen aan den Rijn: Kluwer Law International, 2017) at 21. See also LC, *supra* note 88 arts II, III.

[127] *Convention for the Unification of Certain Rules Relating to International Carriage by Air*, 12 October 1929, 137 LNTS 11 art 1 (entered into force 13 February 1933) [Warsaw Convention]; *Montreal Convention for the Unification*

The partial definitions of space object given by the LC and the RC are not very enlighting as they are circular definitions that add to the uncertainty as they state that "the term 'space object' includes component parts of a space object as well as its launch vehicle and parts thereof."

Article VII of the OST provides that in order for liability to exist, the object must have been launched or procured to be launched "into Outer Space, including the Moon and other celestial bodies." Thus, if the destination of the object is not located in the Outer Space but in the airspace or on Earth, then it is not a space object[128].

To understand what the space treaties meant by launching or procuring to launch "into Outer Space, including the Moon and other celestial bodies," this study proposes to look at the RC which is meant for the registration of "objects launched into Outer Space."[129] Article II of the RC provides that for an object to be registrable it should have been "launched into Earth orbit or beyond." From this article, this research deduces that an object that is not launched or procured to reach Earth orbit is not intended to go into Outer Space. This deduction is made by looking at the object of RC which was to keep track of objects launched to outer space, referred in the treaty as "into Earth orbit or beyond". Suborbital flights do not intend to reach Earth orbit, thus even if successful, the RC does not include them, which is a good reason to deduce that perhaps the drafters of the space treaty did not want suborbital vehicles to be considered as spacecrafts.

An orbit means the "path of a body revolving around an attracting centre of mass," [130] by the action of natural and eventually artificial forces in order to maintain the expected path. Thus,

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of Certain Rules for International Carriage by Air, 28 May 1999, 2242 UNTS 309 art 1 (entered into force 4 November 2003) [Montreal Convention].

[128]See generally Von der Dunk, *supra* note 74 at 87 ("As of now, the only widespread agreement among authors would be that a space object concerns any man-made object which is at least attempted to be physically brought into Outer Space. When, however, a space object is to be defined with reference to an intention to bring it into Outer Space, the latter would still need to be defined.") .

[129] RC, *supra* note 25 at preamble.

[130]"Orbit", *Britannica Academic*, Encyclopædia Britannica, (2015), online: <academic.eb.com/levels/collegiate/article/orbit/57286>. See also "Órbitas terrestres: Clases, aspectos técnicos y

to launch "into Earth orbit" would mean to put an object in orbital motion around the Earth as artificial satellites and the Space Station do. Further, to be launched "beyond" Earth orbit would mean that any object that does not intend nor describe a terrestrial orbit but goes or intends to go beyond where an earth orbit can be described, for example describing an orbit around another celestial body or landing on it, can be considered a space object. Thus, if an object, such in the case of suborbital vehicles, does not follow a circular or elliptical path around the Earth or does not go beyond the gravitational effect of Earth, it should not be considered a space object.

Some authors affirm that suborbital vehicles are spacecraft as they use rocket propulsion to travel in a vacuum. However, not every vehicle that uses rocket propulsion becomes instantly a space vehicle. During and after WWII, different planes have used Rocket Assisted Take-off (RATO) and were never considered spacecrafts. "Most commercial human suborbital systems currently in development are essentially high-performance aircraft that use rocket propulsion to accelerate in the air (rocket burn-out around an altitude of 60 km) while in a parabolic flight." [131]

Considering the above explained, vehicles used for suborbital flights should not be regarded as space objects; they would not be registrable under RC, nor generate liability under the space treaties, nor would States have 'jurisdiction and control' over sub-orbital vehicles if they are to be considered space object[132]. However, these vehicles and their activity should not remain lawless, especially as "many of the vehicles being developed for suborbital flights would qualify as aircraft for the purpose of triggering the application of air law."[133]

jurídicos" (2013) 9 Revista de Derecho, Comunicaciones y Nuevas Tecnologías at 6; NASA, "What is an Orbit?" (9 April 2009) online: *NASA* < https://www.nasa.gov/audience/forstudents/5-8/features/orbit_feature_5-8.html >.

[131] Sgobba, *supra* note 52 at 27.

[132] See OST, *supra* note 60 art VIII.

[133] Carla Sharpe & Fabio Tronchetti, *supra* note 67 at 651.

Indeed, aircraft is defined as "any machine that *can* derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface".[134] When using the word 'can', this definition does not require the craft only to be operated in the way described but to be able to[135]. Thus, most suborbital vehicles would already be in this category[136].

Additionally, suborbital flights are envisaged to share multiple characteristics with the vehicles accepted nowadays as aircraft: using airports for take-off and landing, using the same area to navigate and providing point-to-point transportation, thus potentially interfering with air traffic. In contrast with orbital flights which go to outer space, where sovereignty cannot be exercised[137], when suborbital point-to-point transportation becomes available, the States flown over will probably exercise their sovereignty over the airspace situated over "the land areas and territorial waters adjacent thereto under the sovereignty, the suzerainty, protection or mandate of such State".[138] Thus, sovereignty, safe and secure navigation would be safeguarded by the application of air law to the entire suborbital flight.

2.3. Tort, a shared source of liability for the time being

As long as no special and comprehensive legal regime of space tourism is adopted, and/or existent law is amended to include liability of orbital and suborbital carriers, tort/delict is a shared source of liability for both modes of space tourism. Regarding Orbital flights, the LC "does not

[134] ICAO, Annex 7, *supra* note 113 [emphasis added].
[135] The Chicago Convention exempts State aircraft from its scope (Chicago Convention, art 2). Hence, NASA's Space Shuttle if considered an aircraft, would fall outside its scope. Moreover, according to what this research paper has proposed, the Space Shuttle should not be considered an aircraft. Although exhibiting characteristics similar to an aircraft, the Space Shuttle was an orbital launch vehicle which was intended to go "into Earth orbit or beyond" thus should be considered subject to space law.
[136] Committee A, *United States Suborbital Regime as it Relates to the Use of Civil Aviation Airspace*, ICAO AN-Conf/13-WP/272 (2018) at 3 [United States, suborbital regime] ("some U.S. suborbital vehicles utilize various aviation technologies").
[137] See OST, *supra* note 60 art II. See also OST, *supra* note 60 art VIII ("jurisdiction and control over [the space] object, and over any personnel thereof, while in outer space or on a celestial body").
[138] Chicago Convention, *supra* note 62 arts 1,2.

exclude individuals from pursuing other means for obtaining compensation."[139] As for suborbital flights, they appear to be a lawless activity under international law. Thus, nothing would seem to deter a space tourist from seeking compensation through tort/delict in national fora in the event of damage suffered while being transported on a suborbital or orbital vehicle.

Currently, the applicable law in case of tort or delict committed in "Earth orbit or beyond" is that of the State where the orbital vehicle has been registered. Indeed, although outer space is not subject to any claims of sovereignty, pursuant Article VIII of the OST, the State "on whose registry an object launched into outer space is carried shall retain *jurisdiction and control* over such object, and over any personnel thereof, while in outer space or on a celestial body."[140] In the case of suborbital flights while not considered aircrafts, but flying over a State's airspace when the tort/delict is committed, the *lex loci delicti* would be that of such State. It could be expected that just as in air law, in cases "where the place of injurious impact is fortuitous, the *lex loci delicti* may still in many cases be displaced by the law of a State 'with a more significant' relationship"[141]which has to be determined on a case-by-case basis. At the international level, once suborbital vehicles perform point to point flights, the uncertainty as regards to the applicable law governing tort liability will become pressing unless international air law is deemed applicable.[142]

In the U.S.A. the issue of liability of the carrier has been dealt for now through the "informed consent" for both orbital and suborbital flights[143]. According to current Federal law and regulations,[144] the POSC "may launch or reenter a SFP only if (…)[it] has informed the space flight

[139] Von der Dunk, *supra* note 74 at 90.
[140] OST, *supra* note 60 art VIII [emphasis added]
[141] Paul S Dempsey, *Aviation Liability Law*,2nd ed (Markham:Lexis Nexis, 2013) at 13.
[142] See Mineiro, *supra* note 77 at 400.
[143] See 51 USC § 50905; 51 USC § 50902(7); US, FAA, *Guidance on Informing Crew and Space Flight Participants of Risk Version 1.1* (Washington, DC:2017) online (pdf): <www.faa.gov/about/office_org/headquarters_offices/ast/regulations/media/Guidance_on_Informing_Crew_and_Space_Flight_Participants_of_Risk.pdf>.
[144] 51 USC § 50905 (5); 14 CFR § 460.45 (2018)

participant in writing about the risks of the launch and reentry, including the safety record of the launch or reentry vehicle type (…) [and], prior to receiving any compensation from that space flight participant (…) that the United States Government has not certified the launch vehicle as safe for carrying crew or space flight participants"[145]. This requirement has been known as "informed consent," but it "has raised more questions than answers, albeit in an environment when flight operations have not commenced, and the regime has not yet been subject to the crucible of litigation."[146]It is on the courts to decide if it has the scope of the "informed consent" of medical malpractice, or if it equates to the "duty to warn" of adventure sports, thus exonerating the carriers from liability.

Pursuant to the U.S.A jurisprudence in medical malpractice,[147]determining if there has been failure to comply with the informed consent requirement, the claimant must prove that: "1) an operator/provider failed to disclose a material risk of the activity undertaken or reasonable alternatives (mitigation) to it; 2) that the participant would have chosen against the activity had they been informed; and 3) that as a result of the activity the participant suffered harm/injury."[148] The material risks of space flight have been defined by neither the law nor the regulations and even when the SFP has the opportunity to inquire about "the hazards and risks of the mission,"[149] "there are hazards that are not known,"[150] rendering it impossible to obtain an SFP's "agreement to allow [the space flight] to happen, made *with full knowledge of the risks involved* and the alternatives."[151]

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[145] 14 CFR § 460.45 (2018).
[146] Angie Bukley, Robert Frize & Veronica la Regina, "Space Tourism: Risks and Solutions" in Galliot, *supra* note 22 at 117.
[147] See Tracey Knutson, "What is Informed Consent for Space-Flight Participants in the Soon-to-Launch Space Tourism Industry" (2007) 33 J Space L 105 at 109.
[148] FAA, study, *supra* note 28 at 4.
[149] 14 CFR § 460.45 (f) (2018).
[150] 14 CFR § 460.45 (a)(2) (2018).
[151] Based on the definition given by the *Black's Law Dictionary* (2004) [emphasis added] cited in Upasana Dasqupta, "Legal Issues on Sub-Orbital Space Tourism: International and National Law Perspectives", (2013) 38 Annals Air & Space L 237 at 276 [emphasis added].

The duty to warn is entrenched in adventure sports, and if the concept is applied to private orbital and suborbital flights, the "standard of care" would be met by the POSC in mitigating the risks of the space flight activity like any prudent POSC would do. The information given to the SFP can be a step in this way, but it is certainly not evident to know how the POSC would comply with its duty to warn and to mitigate the risks when not all the risks are known and there have not been enough commercial human space flights to determine what is the standard of care in this type of activities [152].

The risks involved in the fledgling space flight industry and its high-profile clients makes it more important for the POSC to protect themselves from liability claims and disclose as many risks as they can anticipate. Still, based on the adventure activities practice, the informed consent would be only an assumption of inherent risks, and the signature of the informed consent by the SFP cannot be considered a waiver of claims for damages negligently caused to the SFP by the POSC[153].

In the infancy of the commercial space flight industry, and until space flights become frequent and more regulated, it is assumed that the POSC would want to waive its liability. The enforceability of waivers of liability would seem probable in the U.S.A[154]as both the SFP and the operator could be regarded by the courts as "sophisticated and [with] the ability to fairly allocate risks between themselves."[155] However, waivers of such nature would lack enforcement since domestic courts "may impose a duty of care independent of the contractual relationship in order to

[152] Knutson, *supra* note 147 at 112. See also, Melanie Walker, "Suborbital Space Tourism Flights: An Overview of Some Regulatory Issues at the Interface of Air and Space Law" (2007) 33 J Space L 375 at 378.
[153] FAA, study, *supra* note 28 at 25.
[154] Mineiro, *supra* note 77 at 378.
[155] Davis Reed, *supra* note 5 at 603.

protect a vulnerable party in a commercial transaction."[156]Furthermore, some States' legislation and jurisprudence would forbid this kind of waiver.[157]

Moreover, liability exposure for private space flight operators does not disappear even in the existence of "favorable" domestic legislation. California, Colorado, Florida, New Mexico, Texas, and Virginia have friendly statutes that immunize the POSCs from liability, but waivers of gross negligence, willful or wanton disregard, as well as intentional injury would not be enforceable. Additionally, in all these States except Texas and Virginia, the carrier will be liable in cases where it '[h]as actual knowledge or reasonably should have known of a dangerous condition on the land or in the facilities or equipment used in the spaceflight activities and the danger proximately causes injury, damage, or death to the participant'.[158]Considering the multiple risks that can be present, almost any situation could be considered by a judge as fit to apply this clause.

2.4. Conclusion

Private orbital and suborbital flights are different. Whereas space law clearly applies to orbital flights, suborbital flights pose serious questions at the international level as to what legal regime should be applicable. However, both types of flights have in common that regarding carrier liability for damages sustained by the passenger, carriers are exposed to tort liability and at the mercy of courts. International space law is often regarded as public international law for its focus on the rights and obligations of the States, by not considering the private companies as subjects of

[156] *See Martin Marietta Corp v Int'l Telecomms. Satellite Org*, 991 F (2d) 94 (4th Cir 1992) (noting, however, that the present case did not present such a situation).
[157] See Andrea Jean Harrington, *Governing Activities in Outer Space: Responsibility, Liability, Regulation and the Role of Insurers* (LLM Thesis, McGill University Institute of Air and Space Law, 2017) [un-published] (In the U.S.A "three states have held them entirely unenforceable on public policy grounds (Connecticut, Lousiana, Montana) and two leave it as a question for the jury on a case by case basis (Hawaii and Arizona);" In Australia, the waivers are enforceable "Only when it can be demonstrated that the participant had a personal responsibility for their own safety." In Europe, Directive 93/13 considers unenforceable the waivers of liability of an entity "in the event of death or personal injury of a consumer which results from an act or omission of that entity." at 781-784).
[158] Von der Dunk, *supra* note 14 at 694.

rights and obligations, an affirmation which this study shares.[159] Though, for some authors, "liability as such, be it the liability of States or private parties, is a matter of private law."[160]Regardless of how it is considered Space Law to be: public or private law, the fact is that no private or public party, based on the LC can claim compensation from a private orbital carrier without a State being involved.

As for suborbital flights, it is foreseen that they would need to operate in operational compatibility with traditional aviation, as a matter of national air law. At the moment, only the U.S.A. has space tourism capabilities. However, once international suborbital flights begin or more countries get involved in the activity, it will acquire international significance.[161] The decision of whether suborbital flights are to be considered a space activity or an aviation activity should be decided at an international level. This paper proposes that the vehicle performing suborbital flights is not a space object. Therefore, it is not subject to space law regarding liability and that, for its characteristics and purpose, it should be governed by international air law. In this way, these flights would enjoy legal certainty in major legal areas,[162] and those that do not fit the current aviation law could be adapted as has been done with Remotely Piloted Aircraft System[163].

[159] See Von der Dunk, *supra* note 74 at 29.
[160] PPC Haanappel, *The Law and Policy of Air Space and Outer Space: A Comparative Approach* (The Hague: Kluwer Law International, 2003) at 12.
[161] Von der Dunk, *supra* note 74 at 74.
[162] Ferreira-Snyman, *supra* note 19 at 28.
[163] See ICAO "Remotely Piloted Aircraft System (RPAS) Concept of Operations for International IFR Operations" (2017), online (pdf): *ICAO* < www.icao.int/safety/UA/Documents/ICAO%20RPAS%20Concept%20of%20Operations.pdf>; ICAO, "Unmanned Aircraft Systems (UAS)" Cir 328 AN/190 (2011), online (pdf): <www.icao.int/Meetings/UAS/Documents/Circular%20328_en.pdf>

CHAPTER 3: Making space tourism an insurable industry

3.1. Introduction

When there is no certainty about the risks an activity possesses and there is unlimited liability, there is no investment; and without investment there is not enough demand for insurance to exist. Further, if insurance does not exist and there is unlimited liability, the operators are more skeptical to invest in the industry. Thus, we are left with a cyclical problem where, unlimited liability and uncertainty of risk of space tourism does not create an appropriate environment for the insurance industry to fledge and because the insurance industry is not fledgling, space tourism industry is slow to flourish, despite its immense potential. Additionally, the risks can be greater than the expected revenue and the activity becomes uninsurable. Insurance, legal, media, and government representatives have expressed that there are "mixed messages from the operators regarding regulatory regimes. On the one hand, they say they need a relatively lenient licensing regime in order to develop the industry during this evolutionary phase. On the other, they say they need stricter regulation of a certification regime in order to attract significant investment for future development."[164] Rejecting regulation would mean trying to succeed in an industry where liability exists without mitigation, defense, or insurance, all of which could bankrupt the industry[165]. "The safest businesses—in the long run—are the most profitable. When you cut corners, you're actually cutting profits. It might not catch up with you right away. But make no mistake, it will, and it will do so in spectacular fashion."[166]

Space tourism, like the aviation industry, would greatly profit from regulation aimed at increasing safety and limiting liability. After WWI, several American insurance companies started

[164] Bukley, Frize & la Regina, *supra* note 146 at 115.
[165] Mineiro, *supra* note 77 at 398.
[166] Dan Elwell, "To the Stratosphere . . . and Beyond" (June 2019), online: *Air Line Pilot* <www.alpa.org/news-and-events/air-line-pilot-magazine/guest-commentary-elwell>.

to underwrite policies believing that there would be considerable demand for aviation insurance. Even Lloyds of London sent a representative to the U.S.A. However, contrary to what was expected, losses and costs exceeded the premium income. As a result, some companies, including Lloyds of London, discontinued aviation underwriting. The reasons for this disastrous result: lack of regulation. Despite having signed the Paris Convention of 1919[167], planes were not inspected, and the performance of pilots was not tested in the U.S.A. In 1921, insurance companies, underwriting aircraft risks, organized what was known as the National Aircraft Underwriters Association, and established a policy of inspection and registration that reduced insurance losses and insurance premium rates as a result. However, the high standards of the Association only functioned for about two years. In 1926 the federal Air Commerce Act was passed by the U.S.A. government. With regulations and legislation in force and with the Department of Commerce and government officials taking an interest, the commercial aviation boom started in the U.S.A. in early 1927.[168]Hence, far from hindering the nascent aviation industry, the regulation was what helped it to thrive.

Examining the existent law applicable to orbital and suborbital flights[169], it is clear that it needs to be further elaborated in order to make space tourism an insurable industry. Space tourism could greatly benefit from clear rules regarding liability and safety standards, which in turn could increase insurers' trust in the industry and the development of specific insurance for it. International and national law could be the catalysts for meeting these objectives. Thus, a variety of instruments are ideally necessary for encouraging space tourism insurers to invest in the business.

[167] Paris Convention, *supra* note 62.
[168] Walter C Crowdus, "Aviation Insurance" (1931) 2:2 J Air L & Com 176 at 176 — 180.
[169] See Chapter 2, above.

3.2. International Conventions

3.2.1. Developing private international space law for passenger liability

Considering that "existing law is insufficient to meet the challenges of a global space tourism industry," [170] some authors have proposed that liability limitations and the imposition of safety standards could be achieved by a new convention focused on space tourism. [171] Private orbital flights indeed have an impact on international space law. Placing responsibility and liability on the States for the actions of their private nationals is not a sustainable model when a multitude of private actors start offering their services in the outer space or beyond. The situation has made some authors advocate for the creation of "a separate branch of international private law in the form of 'international space private law'."[172]Ideally, the new legal instruments would include private entities liability in the orbital carriage of passengers including "a cap on the amount of claims and types of some claims."[173] A similar approach could be used with suborbital flights to which air law could be applied gradually. In general, "liability should be limited, not waived, […] protecting the industries while they grow and develop."[174]

The differences between orbital and suborbital space tourism highlighted throughout this document suggest that each of these two types of tourism should be treated separately. Certainly, international law will need to provide solutions. Both air law and space law "treaties either need to be re-written to incorporate this reality or new treaties need to be written to encompass this idea."[175]

Long before space tourism, another industry had amazed the public, presented new and uncalculated risks, and had called for new regulation due to its novelty; it was aviation. air Law

[170] Davis Reed, *supra* note 5 at 610.
[171] See *Ibid*.
[172] Peter Jankowitsch, "The Background and History of Space Law" in Von der dunk & Tronchetti, *supra* note 4 at 26.
[173] Malinowska, *supra* note 126. See also Lyall & Larsen, *supra* note 23 at 232.
[174] Varlin J Vissepo, "Legal Aspects of Reusable Launch Vehicles" (2005) 31:1 J of Space L 165 at 216. See also Lyall & Larsen, *supra* note 23 at 232.
[175] Caley Albert, *supra* note 67 at 260,261.

could be used as a guide as to how safety and passenger liability could be regulated. “However, […] it must always be remembered that that regime was structured specifically to meet the peculiarities of that industry.”[176] Thus, aviation law analogy should be adapted to the necessities of orbital and suborbital flights, the first being governed by space law and the second potentially ruled by air law as was proposed in Chapter 2.

Under the 1929 Warsaw Convention, later followed by the 1999 Montreal Convention, passenger liability was first addressed, giving certainty as to the requirements for compensation and limiting liability of air carriers. The Warsaw Convention provided for airlines’ strict liability, provided the conditions for imposing such liability are met, though the carrier can contend contributory negligence, and the usage of "all necessary measures" to avoid the “accident" as defense[177]. Also, the passenger’s compensation was subjected to the existence of “bodily injury” as a result of an “accident.” [178] These provisions meant that passengers would only be compensated for physical injury or moral damage connected to a physical injury resulting from an unexpected event amounting to accident[179]. “This would suggest that under a Warsaw-like regime for commercial human [orbital and suborbital] flight, normal, expected responses […] (such as pressurization sickness, radiation exposure, bone loss, etc.) would not be compensable accidents.”[180]

3.2.2. Towards uniform and stringent safety rules

The 1919 Paris Convention, later replaced by the 1944 Chicago Convention, proposed changes in the international aviation setting as it contained the first comprehensive set of

[176] Freeland, *supra* note 2 at 17.
[177] Warsaw Convention, *supra* note 127 art 20.
[178] *Ibid* art 17.
[179] *Jack v. Trans World Airlines*, Inc., 854 F (Supp) 654 (ND Cal 1994).
[180] Davis Reed, *supra* note 5 at 607.

internationally agreed rules for the safety of flight of aircraft, along with rules of an economic regulatory nature.[181] Among the safety rules, the Paris Convention included the requirement to issue and to render valid the certificates of airworthiness for the aircrafts and of competency and the licenses for "the commanding officer, pilots, engineers and other members of the operating crews" [182]issued by State of nationality of aircraft by other States. This required certain minimum safety standards to be followed by each State and as prescribed under the Paris Convention and later the Chicago Convention.

3.2.3. Inclusion of sub-orbital flights within Chicago Convention regime

Particularly important to suborbital flights is the 1944 Chicago Convention. This Convention is flexible enough to allow the inclusion of most suborbital flights into the scope of the mandate and competence given to the International Civil Aviation Organization (ICAO). Part II of the Chicago Convention specifies that "[t]he aims and objectives of the Organization are to develop the principles and techniques of *international air navigation* and to foster the planning and development of *international air transport*."[183] Article 96 in Part IV defines "international air service" as "an air service which passes through the airspace over the territory of more than one State" and "air service" as "any scheduled air service performed by *aircraft* for the public transport of passengers, mail or cargo." Thus, cross-border transportation with vehicles that "can derive support in the atmosphere from the reactions of the air"[184]could be governed by the Chicago Convention and its Annexes. Further, the current definition of aircraft[185] could be modified to indicate that it includes all suborbital vehicles.[186] It may be noted that definition of aircraft is

[181] Haanappel, *supra* note 160 at 4.
[182] Paris Convention, *supra* note 62 arts 11—13.
[183] Chicago Convention, *supra* note 62 art 44.
[184] ICAO, Annex 7, *supra* note 113.
[185] See *Ibid.*
[186] It is relatively easier to amend the Annexes of Chicago Convention than the Convention itself and definition of aircraft is contained in Annex7. See Paul Stephen Dempsey & Michael Mineiro, "The ICAO's legal authority to

provided in Annex 7 to Chicago Convention and it is relatively easier to amend an Annex, rather than the main text of the Chicago Convention. Consequently, as ICAO has opined, "Sub-orbital vehicles considered as civil aircraft crossing foreign airs paces could then be treated as engaging in international air navigation"[187] and thus being under the aegis of ICAO.

3.2.4. Evaluation

The existence of comprehensive International Treaties governing all international activities without the existence of a patchwork of rules would be the ideal scenery from a legal point of view. However, although agreement can be reached on general principles, "it is almost impossible to reach consensus on treaties dealing in a detailed manner with activities which might have commercial interest."[188] Furthermore, certain rules can become obsolete with technology advancement and the emergence of new applications of what is regulated.

Space law treaties can be particularly more difficult to reach as they must be adopted by consensus as COPUOS, the international space law-making body, works on consensus basis.[189] An example of the difficulty to create a space law treaty is the Moon Agreement which was adopted by the United Nations General Assembly after nine years of discussions. As a result of the negotiations by opposing positions of various States, the Moon Agreement "failed to solve major problems such as the question of lunar stations or the use of natural resources. […] the Moon Agreement is silent as to the detailed rules necessary for the real exploitation of the resources of

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regulate aerospace vehicles", in J Pelton & R Jakhu, eds, *Space Safety Regulations and Standards* (Oxford: Elsevier, 2010); Paul Stephen Dempsey & Michael Mineiro, "ICAO's Legal Authority to Regulate Aerospace Vehicles" in P Kumar, ed, *Space Law: Legal Contours* (2010); Paul Stephen Dempsey & Michael Mineiro, "Space Traffic Management: A Vacuum in Need of Law" in P Kumar, ed, *Outer Space: Warfare and Weapons* (2010); Jakhu, Sgobba & Dempsey, *Supra* note 114.

[187] ICAO, suborbital flights, *supra* note 63 at 5.2.

[188] Oosterlinck, *supra* note 116 at 42.

[189] See e.g. Permanent Mission of France to the UN, "The Committee in the Peaceful Uses of Outer Space (COPUOS)", online: *France Delegation* <onu-vienne.delegfrance.org/The-Committee-in-the-Peaceful-Uses-of-Outer-Space-COPUOS>.

the Moon. Moreover, only [18] States have ratified the Moon Agreement which entered into force on July 11, 1984."[190]

An additional problem with treaties is that in International Public Law, there is no rule for determining *a priori* whether a treaty is self-executing or not.[191] Hence, even if States reach an agreement, the treaty provisions would not be enforceable against private parties unless there are national laws, especially in dualist countries. For example, Art.VI of the OST provides that activities carried out by non-governmental entities shall require authorization and continuing supervision by the appropriate State Party to the Treaty. If the treaty is self-executing, then, no private orbital and suborbital carrier would be able to carry out its activities without the authorization and continuing supervision of the State. On the other hand, if the treaty is not self-executing, then all the activities would be allowed until there are national laws that require authorization.[192]

3.3. Soft Law

Soft law can be defined as "all those social rules generated by State[s] or other subjects of international law which are not legally binding but which are nevertheless of special legal relevance."[193] The relevance of these rules resides on the fact that "recommendations may not make law, but you would hesitate to advise a government that it may, therefore, ignore them, even in a legal argument."[194] Agreement on "non-binding principles, norms, standards or other statements of expected behavior in the form of recommendations, charters, terms of reference, guidelines,

[190] Oosterlinck, *supra* note 116 at 42.
[191] See *Ibid* at 43.
[192] See *Ibid*.
[193] D. Thurer, "Soft Law", in R Wolfrum, ed, *Encyclopedia of Public International Law*, Vol IX (2012). See also Jankowitsch, *supra* note 172 at 25.
[194] Robert Y. Jennings, "What is international law and how do we tell it when we see it?," The Cambridge-Tilburg law lectures , (3rd series, 1980) 14, as quoted in Steven Freeland, "The Role of 'Soft Law' in Public International Law and its Relevance to the International Legal Regulation of Outer Space" in Irmgard Marboe, ed, *Soft Law in Outer Space: The Function of Non-binding Norms in international Space Law*, (Viena: Bohlau Verlag, 2012) at 28.

codes of conduct"[195]can be achieved in a more expeditious way than international conventions. However, some soft law can take an enormous amount of time. "For example, it took almost 10 years to negotiate the Nuclear Power Principles." [196] Even so, it is possible that if it had been hard law (e.g., a treaty), it would have taken longer to reach consensus, especially if the subject matter is controversial. Contemporary examples of soft law which have been widely adopted could be the Manual on the Regulation of International Air Transport (Doc9626) and the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space [197]

In the air law realm, ICAO has manifested that "should, […] foreign airspace(s) be traversed, and should it be eventually determined that sub-orbital flights would be subject to international air law, pertinent Annexes to the Chicago Convention would in principle be amenable to their regulation."[198] The Annexes to the Convention are not part of the Convention but are standards and recommended practices developed by ICAO under the mandate received through the Convention, with the objective of implementing the Convention provisions. States have to abide by the SARPs unless they have filed differences to the same.[199] For example, articles 31,32 and 33 of the Chicago Convention establish the duty of States to provide their aircraft with certificates of airworthiness and their pilots and crew with licenses, as well as to recognize the certificates and licenses issued by the other States. However, the conditions to issue certificates and licenses were not defined by the Chicago Convention, leaving this task to ICAO, which in the pursuit of

[195] M Ferrazani, "Soft Law in Space Activities – An updated view", in Marboe, *supra* note 194 at 100.
[196] Freeland, *supra* note 194 at 28.
[197] Jankowitsch, *supra* note 172 at 27.
[198] UNCOPUOSOR Legal Subcommittee, *Concept of Suborbital Flights: Information from the International Civil Aviation Organization (ICAO)*, 49th Sess, UN Doc A/AC.105/C.2/2010/CRP.9 (2010).
[199] Chicago Convention, *supra* note 62 art 38.

harmonization, issued SARPs on the matter with the collaboration of States parties (Annexes 1, 2, 6, 8 and 18).[200]

As for the consequences for non compliance, "States that fail to adhere to the SARPs promulgated by the Council – whether standards or recommended practices – are likely to incur losses to reputation;"[201] this can derive in warnings from other States to their passengers and airlines to not to fly to defecting States, or to avoid deepening ties until the defector proves adherence to SARPs. "Adherence to SARPs is strongly incentivized, therefore, even in the absence of a direct sanction under the Convention."[202]

In addition to SARPs, ICAO has issued other soft law instruments like the "agenda-setting documents," such as the Global Aviation Safety Plan adopted by the ICAO Assembly in 1998, as well as detailed manuals and circulars to guide States in their implementation of ICAO's rules. ICAO has also sought implementation of safety standards by helping to create and work with Regional Safety Oversight Organizations (RSOOs)[203]. ICAO is constrained in its ability to enforce SARPS[204], therefore, it provides aid to the States that struggle to complain and has adopted an oversight program whose results are made available to other States, allowing for certainty in regards of the situation of each State's "capability for monitoring and implementing compliance

[200] Although SARPs are generally considered soft law, it could be contended that from the articles of the Chicago Convention, SARPs are titled more to the hard rather than the soft side of the law[200]as they contain clear and obligatory rules. Article 37 obligates the States to "collaborate in securing the highest practicable degree of uniformity in regulations, standards, procedures, and organization" in relation to all matters "in which such uniformity will facilitate and improve air navigation", leaving for ICAO the task to "adopt and amend from time to time" SARPs. Article 38 obligates the States to inform ICAO immediately if they are unable to comply with SARPs and to notify of any differences, which is done through the "Electronic Filing of Differences" System. In the case of amendments to standards, States must notify within 60 days if they did not include it to its regulations or practices. Finally, Article 54 vests the Council with the power to adopt SARPS and to designate them as annexes, while notifying to the States parties. Article 90 provides that an annex becomes effective within three months after it is submitted under article 54.
[201] Brian F. Havel & Gabriel S. Sanchez, *The Principles and Practice of International Aviation Law* (New York: Cambridge University Press, 2014) at 67.
[202] Ibid.
[203] See Ibid at 178.
[204] See Ibid at 179.

with ICAO safety SARPs"[205]. Thus, the institutional and legal framework for international aviation safety oversight is more collaborative, ICAO driven, less controversial, less reliant on State-State bilateral agreements, and it is highly technical,[206] characteristics that would help in the establishment of clear standards and practices for cross-border suborbital flights if it is decided that air law is applicable. In the meantime, ICAO has decided to desist (at least for the time being) from developing standards and recommended practices (SARPs) for such sub-orbital vehicles or the operations conducted with them;[207] thus leaving that task to national law. However, once suborbital flights are included under air Law, ICAO has expressed that Annexes to the Chicago Convention would apply:

> As regards any applicability of international air law to sub-orbital flights, pertinent Annexes to the Chicago Convention contain associated communication, navigation, surveillance, licensing, operation and airworthiness issues, among others, that would be amenable to their regulation. However, ICAO Annexes currently lack technical requirements in this area. Should it be determined that such sub-orbital vehicles should be governed by international air law, Assembly Resolution A35-14, Appendix G nevertheless acknowledges that for certain categories of aircraft or classes of airmen, it may be many years before SARPs come into force or that it may be found most practicable not to adopt SARPs. Accordingly, Resolving Clause 2 stipulates that 'certificates and licences issued or rendered valid, under national regulations, by the Contracting State in which the aircraft is registered shall be recognized by the other Contracting States for the purpose of flight over their territories, including landings and take-offs.' [208]

Regarding orbital flights, international standards should be developed for ensuring the enhancement of safety levels and to prevent safety levels from being compromised. Currently, when a space launch is scheduled, the airspace through which the vehicle will ascend or descend is restricted. However, if orbital flights become more frequent, it is important to develop ways in which the restrictions do not affect commercial aviation nor represent a safety risk. Development

[205] Ibid at 180.
[206] Brian Havel, "Public International Air Law", (Lecture delivered at McGill University Institute of Air and Space Law, Montreal, Canada 28 November 2018).
[207] See ICAO, suborbital flights, *supra* note 63.
[208] *Ibid* at 4.

of SARPs and guidance material from ICAO would be significant as to how to coordinate international aviation in the presence of space launchings.[209] It will be "critical in ensuring this growth [of the space industry] is accommodated in a safe and orderly manner.[210]

In the interim, until hard law is adopted on space tourism, soft law can "provide clarity and legal certainty on issues such as liability and the status of space tourists." [211] Even after international treaties or protocols come into force, soft law will continue to play an important role for space launch itself through guidance materials, manuals, and standards like those of the aviation industry.

3.4. National laws and regulation of space tourism

National law and regulations are important instruments for a nascent industry such as space tourism. At the international level, national law and regulations can implement what has been agreed between the States and they can be demonstrative of State practice,[212]at the domestic level, they bring legal certainty to activities that do not cross the borders. This is even in more important in dualist States where treaties are not self-executing.

In Space Law, the OST does not give details on what kind of rules a State should implement in order to comply with authorizing and continually supervising the activities of its non-governmental entities. Nevertheless, the OST imposes international responsibility on the appropriate State party for said activities. Similarly, the LC places liability on the State and not on their private entities. These aforesaid provisions, incentivize States to regulate.[213] Thus, national

[209] See on the matter of space and air traffic issues ICAO, "Integrating Public Safety Standards for Commercial Space and Aviation (Presented by the United States)" AN-Conf/13-WP/205 (2018), online (pdf): *ICAO* <www.icao.int/Meetings/anconf13/Documents/WP/wp_205_en.pdf>; ICAO, "Safety Management Systems for Space Operators (Presented by the Civil Air Navigation Services Organisation (CANSO))" AN-Conf/13-WP/178 (2018), online (pdf): *ICAO* <www.icao.int/Meetings/anconf13/Documents/WP/wp_178_rev2_en.pdf>.

[210] IFALPA, "Commercial Space Operations, Position Paper" (9 July 2019), online: *IFALPA* < https://www.ifalpa.org/media/3394/19pos06-commercial-space-operations.pdf> at 2.

[211] Ferreira-Snyman, *supra* note 19 at 16.

[212] Freeland, *supra* note 194 at 27.

[213] Matthew Schaefer, "Analogues between Space Law and Law of the Sea/International Maritime Law: Can Space Law Usefully Borrow or Adapt Rules from These Other Areas of Public International Law?" (2013) 3 Proceedings IISL 2012 316 at 320.

regulation plays an important role in ensuring the compliance with international law by incorporating them into the national legislation, making them "directly applicable and enforceable, which is not necessarily the case with obligations of a public international law nature."[214]

The United States has been a pioneer regulating space tourism by developing national law Currently, every launch or re-entry in the U.S.A. or outside the U.S.A. but performed by citizens of the U.S.A. or corporations or other entities organized under the law of the U.S.A. needs a license. Moreover, corporations or other entities under the controlling interest of U.S.A. citizens or corporations require a license from U.S.A. unless there is a pertinent agreement between the foreign government and the U.S.A.[215]

Further, bearing in mind the lack of delimitation between airspace and outer space, the U.S.A. has decided to consider suborbital flights as spaceflights;[216] thus, including the launch and reentry of suborbital and orbital vehicles under its space law. Regarding the flying path of the vehicles, notoriously, the FAA has not been given explicit 'on-orbit' jurisdiction by the U.S.A. Congress.[217]Thus, the mandates given to the U.S.A. by Articles VI and VIII of the OST of continuous supervision of the activities carried out by private entities in outer space and retention of jurisdiction and control, could be being neglected in the case of orbital flights.

As the current international space law only provides for third-party liability (see 2.2.1), license applicants must obtain policy and safety approvals from the FAA for damages to third parties and government facilities. In addition, they are required to take out insurance or otherwise demonstrate their ability to compensate liability claims brought by third parties or the U.S.A. government for damage to government property resulting from the licensed activity. The 2004

[214] Marboe, *supra* note 98 at 128.
[215] See 51 USC § 50904(a) (4), See also *Ibid* at 142.
[216] See United States, suborbital regime *supra* note 136 at 3.
[217] 51 USC § 50904 (2018).

CSLA requires orbital and suborbital flight operators to obtain the 'informed consent' of customers, the so called 'space flight participants'.[218] This system, in principle – see 2.3 - establishes that the SFP, and not the operator bear the risk and that they are not entitled to the benefits of the third-party liability insurance coverage.[219]

Russia, the other space-faring pioneer, establishes in its laws and regulations that private sector participation in space activities is possible but "the regulation of 'space tourists' is still done on a case-by-case basis."[220] Concerning insurance, the Russian Law on Space Activities establishes a two-tier system of compulsory and voluntary insurance of space activities. Insurance is compulsory with regard to the health and life of cosmonauts, space infrastructure personnel and liability for damage caused to the life, health or property of third parties.[221] Although it is not clear if space tourists fall in any of the categories mentioned, interestingly all the space tourists that have traveled onboard a Soyuz spacecraft, have had PAI.

Currently, passenger liability insurance would not be a product that insurers would be interested in developing until there is more legal certainty. However, this could change as national law could moderate the liability exposure faced by private space tourism carriers in the event of an accident by implementing limits to liability, establishing safety requirements for the passengers and requiring insurance. Additionally, once passenger liability insurance is in existence, the insurance premium rates could be very high for the carriers. Thus, national law could institute publicly subsidized insurance "with tax-based policies in the form of tax credits or deductions to underwrite the purchase of insurance."[222]

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[218] 14 CFR. §460.45 (2009).
[219] Marboe, *supra* note 98 at 142, 143.
[220] *Ibid* at 148.
[221] Russian Law, *supra* note 98 art 25. See also *Ibid* at 147.
[222] Mineiro, *supra* note 77 at 398.

National legislation can present multiple advantages when developed following the principles and rules of existent international law by complementing it. The disadvantage of relying solely on national law to regulate the activity of private companies in outer space and new activities like suborbital flights, is that there can be multiple regulations by different States that can make the labor of performing an activity very confusing and tedious, hindering the creation of a level playing field in the space sector. As we saw in aviation, in case of international travel, uniformity is very important. Even though the domestic legislation of different States may seek to regulate the space tourism industry and provide for standards and protections, there is a danger that this will lead to a lack of uniformity, giving rise to uncertainty in this important area.[223] "In a situation of many diverse national legal frameworks, the phenomena of 'national planning' or the choice of `flags of convenience' as known from the law of the sea, are potential problems."[224] Consequently, international conventions must exist to guide the principles which national legislation and practice will rest.

3.5. Conclusion

Space tourism is a new venture which will need legal and economic support. International conventions, soft law, and national law and regulations are decisive for space tourism to become a vital commercial enterprise. The development of specific insurance for space tourism, and especially, passenger liability insurance, will only be possible when clear safety standards are imposed and overseen, and when limits are established on the liability of owners and operators of space facilities and vehicles including the carriers.

Existing space and air law constitute a starting point from which regulation for the new activities can be developed. What is important in this context is that there should be no legal

[223] Freeland, *supra* note 2 at 16.
[224] Marboe, *supra* note 98 at 128.

vacuum in relation to space tourism activities. International and national law, as well as the industry, must work jointly to implement appropriate safety standards[225] and prompt responses when an orbital or suborbital passenger suffers injury.

In order to reach a state where tort liability risks can be predicted and mitigated with a high degree of precision, it is necessary that legal harmonization be achieved at both the domestic and international levels.[226] Until that is achieved, the industry is subject to a multiplicity of jurisdictions with varying legal standards creating uncertainty resulting in, inability to acquire liability insurance at affordable rates, all of which can impact the industry.

[225] See for example, Phillip Dann, "The Future of Municipal law in Regulating Space-Related Activities" in Tanja L Zwaan, ed, *Space Law: Views of the Future*, (Deventer: Kluwer Law and Taxation, 1988) at 131.
[226] Mineiro, *supra* note 77 at 400.

CONCLUSION

Just as aviation revolutionized transportation and became more efficient than trains and ships suborbital flights will be another option in modes of transportation. Space tourism is not science fiction anymore: going to the ISS is a reality and, although visiting private space stations or the moon may take time, it is bound to happen in near future. Further, there is no doubt that private suborbital flights are imminent. "It is the next logical step in the evolution of the commercial flight market."[227] Operators have a strong incentive to pursue successful results in the quest to provide safe space tourism options in a speedy fashion. Customers have already given deposits to reserve a seat in the vehicles currently under development. "Should the vehicles not be delivered, or perform as expected, the operators run the risk of losing significant sums of money."[228]

However, space tourism is in its development stage. The lack of experience in these new activities, which present distinct characteristics, cause the risks to be extremely difficult to assess. Hence, there are no specific insurance products available in the space tourism market besides personal accident insurance for the passengers and crews that have traveled to the ISS. Thus, without certainty about the legal and technical risks, the possibilities for the appearance of specific insurance for space tourism are low. For risks to be insurable, at least two criteria must be met: 1) A definite loss, where the time at which it takes place and the cause and value are known and 2) the loss is quantifiable.[229]

New rules regarding orbital flights should be developed where a system of limited carriers' liability is established. The existing rules of international space law, which are intended to place

[227] Bukley, Frize & la Regina, *supra* note 146 at 107.
[228] *Ibid* at 112.
[229] Malinowska, *supra* note 126 at 258.

responsibility and liability on the States, are not appropriate for the private space tourism industry. Creating a coherent legal framework will be beneficial to all the interested actors. It will give legal certainty as to what is the carriers' liability exposure and will also procure the prevention of accidents and collisions.[230]

Incorporating suborbital flights into the aviation existing regime would provide further protection for the industry to develop under the expert guidance of a highly technical organization as ICAO.[231] Contrary to orbital flights, where more experience exists from the travel of space tourists and astronauts to outer space, there is even less information on the risks associated with suborbital vehicles; however, many of them could be considered airplanes and all of them will potentially be used for point-to-point transportation in the near future. Special norms can be adopted in order to guide the transition of suborbital flights and vehicles to the standards used for commercial aviation.

Before a space tourism accident occurs, it is important to determine whether air law or space law should be applied to private orbital and suborbital carriage of passengers. Irrespective of applicable legal regime, both orbital and suborbital space tourism will need appropriate safety standards pertaining to the design, construction, operation of the vehicle and suitability for the crew. All this should be coupled by a system of responsibility and liability at the international level (hard law and soft law) supplemented by national law and regulations "so as to remove uncertainties and ensure proper risk avoidance procedures are put into place."[232]

[230] Marboe, *supra* note 98 at 187.
[231] Vissepo, *supra* note 174 at 213.
[232] Steven Freeland, *supra* note 2 at 15.

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