LEGAL AND REGULATORY CHALLENGES TO LEVERAGING INSURANCE FOR COMMERCIAL SPACE

Andrea J. Harrington[*]

I. OVERALL CONSIDERATIONS

A. Introduction

When a private entity seeks to place a satellite in orbit, the two greatest expenses in pursuing this goal are obvious and heavily considered: the cost of the satellite itself, and the cost of the launch. There has been a great deal of discussion and literature regarding the issues of satellite cost, such as the impact export controls have on efficient international development and cooperation, and the need to find less costly launching solutions, such as reusable vehicles and cheaper fuel. What is not often discussed, however, is the third greatest expense for private entities: insurance, which is the most important means for risk management (both for governments and the private sector, particularly given the assignment of liability under the international space law regime). A launch insurance policy alone can cost anywhere from 7% to 20% of the insured value of a satellite. While large companies with significant financial backing can "self-insure" their satellites, this is not an option for smaller or emerging companies. In order for the private space sector to innovate and expand, insurance costs must be taken into consideration. An efficient capacity increase in the space insurance industry would benefit not only

[*] Dr. Andrea J. Harrington serves as the Associate Director of the LL.M. Program in Air and Space Law at the University of Mississippi School of Law and is an admitted attorney in the Commonwealth of Massachusetts. Prior to joining the faculty at the University of Mississippi, Dr. Harrington was an Erin J.C. Arsenault Fellow in Space Governance at the McGill University Institute of Air and Space Law. This article is drawn from her Doctor of Civil Law thesis and in part from a conference paper produced for the 3rd Manfred Lachs International Conference on NewSpace Commercialization and the Law, which was held at ICAO Headquarters in Montreal in March 2015.

those private entities seeking insurance, but also the industry itself.

In Part I, this Article explores the issues inherent in the offering, procurement, and handling of traditional areas of space insurance (pre-launch, launch, and on-orbit), including first, second, and third party liability, for the purpose of providing public policy and regulatory explanations and recommendations. The international space law regime is presented as a context for the overall analysis and discussion. This paper includes analysis of the impact of ITARs, State liability for private space actors, and liability waivers on the provisioning of insurance for space enterprises to aid companies in navigating the legal and regulatory environment. This discussion also includes the individual U.S. State Spaceflight Liability and Immunity Acts that have been implemented by several of the major U.S. commercial spaceport states.

In Part II, this Article focuses on the issues particular to insuring suborbital or hypersonic vehicles. This discussion includes an introduction to such vehicles and their unique characteristics, an evaluation of air law and aviation insurance as relevant to these types of space activities, and safety considerations that may be relevant under the international air law regime. Finally, Part III offers concluding thoughts and recommendations for moving forward.

The space insurance industry emerged as a separate field of insurance in 1965. Then, the first pre-launch and on-orbit insurance for a commercial satellite was issued, while the first launch insurance was provided in 1968.[1] It is amazing to think that a mere eight years after the first launch of any artificial satellite (*Sputnik*, launched by the government of the U.S.S.R.) insurance was being provided for a satellite on a commercial basis. Since then, there has been significant growth and evolution of the industry. Communication satellite problems, spacecraft and launch failures, increasing space debris, and cyclical periods of high solar energy all contribute to space insurance being considered a "high risk" field of insurance. The increase in the number of private actors in the space industry as well as the rapid development of space laws are indicators of growth in the commercial space sec-

[1] Rod Margo, *Some Aspects of Insuring Satellites*, 10 INSURANCE LAW JOURNAL 555 (1979), 556.

tor. As early as 2008, the insured value of the in-orbit insured satellite fleet alone was USD 17.5 billion.[2] There has been an ongoing growth in entrepreneurial space activity. In 2009, the estimated total investment to the spaceflight industry was USD 1.46 billion. Of this investment, government contribution made up only 15%. In 2010, of the almost 1,000 operational satellites in orbit, only 175 commercial satellites were insured.[3] As of 2015, the space insurance market covers approximately 205 satellites orbiting the Earth with a value of approximately $26 billion.[4]

"The most successful launch insurance policy ever negotiated at least for a satellite service provider was 7% of the insured value for the satellite and launch vehicle. The typical cost of launch insurance today will likely range from 15% to 20% of the insured value."[5] This high cost of insurance and relatively low capacity of the market acts as a barrier to entry in the space industry for emerging companies. In an era when motivations for space activities are being re-evaluated, and while private companies are encouraged by such programs as the X Prize to participate in space activities, it is critically important that the insurance industry be ready and able to provide the necessary coverage to support the space industry.

The United States Congress acted in 1988 to deal with the space insurance problem, by requiring cross-waivers of liability in space activities. "Prior to the passage of the 1988 Amendments, this country's private commercial space launch industry faced virtual shutdown because commercial launchers incurred huge liability risks and were unable to procure insurance at any price."[6] Though this approach was able to reverse the degradation of the space industry in the United States, it did not solve the problem of the limited availability and expense of insurance. While it rendered the participation in space activities possible without the burden of insurance, it is unquestionable that the availability of

---

[2] Chris Kunstadter, *Space Insurance: Why it Matters*, ISPCS 2013 (2013). Pdf.

[3] ORG. FOR ECON. CO-OPERATION AND DEV., THE SPACE ECONOMY AT A GLANCE 2011, (2011). 66, 31.

[4] Scott Ross, *Risk Management and Insurance Industry Perspective on Cosmic Hazards* in HANDBOOK OF COSMIC HAZARDS AND PLANETARY DEFENSE (J.N. Pelton & F. Allahdadi, eds. 2015) at 1096.

[5] JOSEPH N. PELTON, SATELLITE COMMUNICATIONS (2011). 82.

[6] Martin Marietta Corp. v. INTELSAT, 763 F.Supp. 1327, 1330 (D. Md. 1991).

reasonably priced, comprehensive insurance would encourage further growth and development.

"Insurance for space activities has evolved over many years through the collaboration of aerospace clients, brokers, and the underwriting community worldwide. The goal of that work was to provide flexible forms of insurance for a volatile class of exposure, which was not yet quantified by loss data."[7] In general, the space insurance market is a particularly unbalanced market, with a few accidents resulting in significant financial consequences.[8] Given its importance to the success of the commercial space industry, it requires special attention.

B. Types of Insurance

i. Liability Insurance

Generally speaking, there are three main types of liability insurance – first, second, and third party. The party to contract for space insurance will be the one bearing the risk of loss.[9] "Similar to most commercial air transport insurance contracts, the space insurance policy is usually underwritten in syndicate where each individual underwriter assumes a percentage of the risk."[10] First party insurance covers losses sustained by the insured. In the case of space operators, claims are generally for total or partial loss of a spacecraft (including constructive total loss) or for delay in deployment. This insurance can cover, among other issues, physical damage, faulty design, ground operator mistake, inadequate testing, or performance reduction, depending on the policy wording.[11] Generally, a loss will be covered if the status of the satellite fulfills the "loss" definition in the insurance contract and the satellite or a portion thereof cannot be used for its intended purpose.[12] The sums insured can range from as little as USD 10 million to as

---

[7] Piotr Manikowski, *The Columbia Space Shuttle Tragedy: Third-Party Liability Implication for the Insurance of Space Losses*, 8 RISK MANAGEMENT AND INSURANCE REVIEW 141, 142 (2005).

[8] GABRIELLA CATALANO SGROSSO, INTERNATIONAL SPACE LAW (2011). 479.

[9] Philippe Montpert, *Space Insurance in* CONTRACTING FOR SPACE 283, 286 (2011).

[10] Ruwantissa Abeyratne, *Synergies and Problems in Outer Space Insurance and Air Transport Insurance*, 30 TRANSP. L. J. 189, 191 (2003).

[11] Montpert, *supra* note 9, at 285.

[12] *Id.* at 286.

much as USD 450 million.[13] Damages paid between the late 1970s and early 1980s on these insurance policies were over USD 850 million, but the total premiums collected and retained were only USD 445 million; as a result, in the period following this spike in claims, the cost of insurance rose by 20-30%.[14] Thankfully, since the 1990s, insurers have achieved a satisfactory premium-to-damage ratio.[15]

Insurance for second party liability has thus far been less relevant in the space arena, as it would cover passenger liability. As paid spaceflight participant voyages have not yet commenced, this is an emerging area of space insurance. It bears similarities to insurance for passenger liability in aviation, for example. Commercial operators can require spaceflight participants to maintain a certain level of insurance in order to participate,[16] which would be a wise move going forward. This issue is discussed further in Part III.

Third party insurance is the insurance that covers damage to third parties; those individuals and companies who are not in contract or relationship with the insured. No third party liability claims have been made in over two hundred commercial launches licensed in the U.S. since 1989.[17] Aside from the *Cosmos 954* negotiation between Russia and Canada, the only third party liability claim made worldwide was in the amount of one million USD for ground contamination in Kazakhstan as a result of a failed Proton launch in 2007.[18] Thus, this is a low probability area of insurance with high potential losses.

---

[13] *Id.* at 287.

[14] Sgrosso, *supra* note 8, at 474.

[15] *Id.* at 477.

[16] Pamela Meredith and Marshall Lammers, *Commercial Spaceflight: The 'Ticket to Ride'*, 25 NO. 1 AIR & SPACE LAW. 4, 7 (2012).

[17] Matthew Schaefer, *The Need for Federal Preemption and International Negotiations Regarding Liability Caps and Waivers of Liability in the US Commercial Space Industry*, 33 BERKELEY J. INT'L L. 223, 232 (2015).

[18] Montpert, *supra* note 9, at 284.

ii. Insurance Phases

Space insurance policies are often referred to as "all risk" policies, though critically, they are not "all loss" policies.[19] There are three main "phases" of space insurance policies – pre-launch, launch, and in-orbit (or "life") insurance. Pre-launch insurance is designed to cover risks from the beginning of the program (or the effective date of the policy). Risks that are covered include incidents during satellite construction or during the integration of its systems, transportation, storage, and placement on the launch vehicle and launch pad. It is possible to also insure a risk of launch delay as part of the pre-launch insurance policy. [20] Generally, this phase of insurance ends upon first ignition of the launch vehicle or at the point when the launch process becomes irreversible.[21]

The highest premium cost and riskiest phase of insurance is the launch phase. This portion of the policy will be in effect from three to six months and includes placement of the satellite in its correct orbit and preparation of the satellite for its operational activities. The in-orbit phase commences at the end of the satellite operational capacity assessment. Generally, policies are negotiated on a year-to-year basis for the operational life of the satellite. There can be partial or total loss under in-orbit insurance, depending on whether or not the satellite can still perform a significant portion of its intended function. Partial losses can occur where some, but not all transponders are functioning.[22] The percentage of premium rate for each phase is determined by the probability of failure in that phase.[23]

C. The Impact of Export Controls

Insureds are under a strict contractual obligation to provide technical and non-technical data in the form of underwriting information; failure to provide this information can result in the

---

[19] Stephen Tucker, *Some Strategic Defense Initiatives Toward Preventing U.S. Space Insurance Related Disputes and Litigation*, 21 J. SPACE L. 123, 126 (1993).

[20] Sgrosso, *supra* note 8, at 491-492.

[21] Montpert, *supra* note 9, at 283.

[22] Sgrosso, *supra* note 8, at 492-493.

[23] Montpert, *supra* note 9, at 283.

denial of a claim.[24] Not only are technical details required by the insurer in order to initially underwrite the policy, but space insurance policies typically contain a material changes condition requiring that the insured notify the insurer of any material changes; failure to notify would result in lack of coverage in a case where the change led to a loss.[25]

Satellites and related technologies have generally fallen under the set of regulations known as the International Traffic in Arms Regulations (ITARs), which are administered by the U.S. Department of State,[26] though the National Defense Authorization Act of 2013 has authorized the U.S. President to move satellite technologies from the ITAR list to the Commerce Control List (CCL).[27] Items that are on the CCL are subject to the less restrictive Export Administration Regulations (EARs), which are administered by the Department of Commerce and which require a license to export. President Obama undertook an initiative to revise the export control regime, clarifying those items that are included on the list and those that could be moved to the CCL.[28] Under Department of Commerce rules, companies can determine themselves whether their activity is exempt from licensing, unlike with regard to ITARs.[29] Revisions have been made to Category IV of the U.S. Munitions List (subject to ITARs), which includes launch vehicles.[30]

Exporting, in the context of ITARs, is defined broadly and includes not only physically sending or taking an article beyond the borders of the U.S., but also transferring control or ownership (including on-orbit transfer), and notably disclosing technical data to foreign persons (in the U.S. or elsewhere, including oral or visual disclosure).[31] The Directorate of Defense Trade Controls can issue

---

[24] Montpert, *supra* note 9, at 285.

[25] Tucker, *supra* note 19, at 128.

[26] U.S. DEP'T OF COMMERCE & FED. AVIATION ADMIN., INTRODUCTION TO U.S. EXPORT CONTROLS FOR THE COMMERCIAL SPACE INDUSTRY 3 (2008), https://www.faa.gov/about/office_org/headquarters_offices/ast/media/intro to us export controls.pdf.

[27] National Defense Authorization Act for Fiscal Year 2013, U.S. PUB.L. 112-239.

[28] 79 Fed. Reg. 22740 (2013).

[29] Matthias Creydt and Kay-Uwe Horl, *Export Control Issues in Space Contracts in* CONTRACTING FOR SPACE 292 (2012).

[30] 79 Fed. Reg. 34 (2013).

[31] 22 C.F.R. § 120.17 (2016).

authorizations in the form of licenses, agreements, or exemptions for exports.[32] Any launch of U.S. satellite technology from a non-U.S. territory or involving non-U.S. entities or personnel, will require compliance with ITAR requirements; this includes participation in multinational launch consortia. The respective ITARs and EARs must be followed, and the FAA will verify appropriate licensing before a launch license is provided.

There are not many insurers worldwide that maintain specialized space risk departments. Those that do are based in the U.S., U.K., France, Italy, Switzerland, and Germany.[33] Export controls also apply to technical data furnished to insurers, causing serious difficulty obtaining quotes for insurance premiums and obtaining reinsurance.[34] Where such a significant proportion of total cost of a project is dedicated to insurance premium, barriers to both price and policy shopping are highly undesirable. Furthermore, with the shifting U.S. export control regulations, consistent monitoring is necessary for efficient and effective compliance.[35]

D. State Liability

Space law is a functional classification of those rules of international and municipal law governing outer space.[36] With regard to space risks, "underwriters are at least clear that the assessment of exposure for operations in outer space should be done on the basis of the Liability Convention."[37] Therefore, it must be noted that in the regime established by the Outer Space Treaty and Liability Convention, Launching States[38] are responsible and liable for the space activities of their nationals.[39] In international law, "[r]esponsibility is the necessary corollary of a right. All

---

[32] 22 C.F.R. § 120.1 (2014).

[33] Montpert, *supra* note 9, at 286.

[34] Creydt and Horl, *supra* note 29, at 293.

[35] *Id*.

[36] BIN CHENG, *STUDIES IN INTERNATIONAL SPACE LAW* 383 (1997).

[37] Margo, *supra* note 1, at 565.

[38] Convention on International Liability for Damage Caused by Space Objects art. I, Oct. 9, 1973, 24 U.S.T. 2389, 961 U.N.T.S. 187.

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

rights of an international character involve international responsibility. If the obligation in question is not met, responsibility entails the duty to make reparation."[40]

The Liability Convention is an elaboration of Article VII of the Outer Space Treaty,[41] which has, in conjunction with the State responsibility requirements of Article VI, become part of customary international law.[42] Article VII states:

> Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air or in outer space, including the moon and other celestial bodies.

Liability arises under the Article VI of the Outer Space Treaty in the sense that such liability is imposed as a secondary obligation flowing from the attribution of space activities to the State.[43] Importantly, Article VI states, in relevant part, that:

> States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty.

This provision subjects States to responsibility for the activities of their nationals in outer space, including the authorization

---

[40] Spanish Zone of Morocco Claims, Report 111 (1924) 2 U.N.R.I.A.A. 614 at 641.

[41] Ram S. Jakhu, *Legal Issues Relating to the Global Public Interest in Outer* Space, 32 J. SPACE L. 31, 52; Cheng, *supra* note 36, at 636.

[42] FRANCIS LYALL & PAUL B. LARSEN, *SPACE LAW: A TREATISE* 71 (2009).

[43] Ricky J. Lee, *The Liability Convention and Private Space Launch Services – Domestic Regulatory Responses,* 31 ANN. AIR & SP. L. 351, 359 (2006).

and supervision of such activities. With regard to the Liability Convention,

> An assessment of the terms of Articles 3 and 7 of the 1967 treaty makes it clear that international law is generally relevant to the liability of states for launching space objects and for the space activities resulting from those launches. Because international law is applicable to such conduct, it is important to identify some international principles concerning space activity that do not derive from formal treaties.[44]

States are responsible for their internationally wrongful acts.[45] **"**Any violation by a State of any obligation, of whatever origin, gives rise to State responsibility.**"**[46] In international law, the breach of treaty obligations is just such a violation. In accordance with the holding in the *Chorzów Factory* case, there are three elements of liability in international law: a legal obligation owed by a State, an act by the State which breaches that obligation, and an apparent link between the wrongful act and the damage caused.[47] A failure of authorization and continuing supervision of a private space activity in and of itself constitutes a cause of responsibility under international law and Article VI of the Outer Space Treaty.[48] The applicable standard in this situation would be a due diligence standard.[49] Once that standard is met, a State**'**s responsibility kicks in when the breach is committed, therefore it does not matter when the act or omission is discovered for the purposes of incurring responsibility.[50]

The *Corfu Channel* case also established the 'knew or should have known' international legal standard for liability.[51] This is both the general fault standard in customary international law, and presumably the standard that would be applied for fault liability under Article III of the Liability Convention, which states:

---

[44] CARL Q. CHRISTOL, *SPACE LAW: PAST, PRESENT, AND FUTURE* (1991), 212.

[45] Corfu Channel Case (U.K. v. Alb.) 1949 I.C.J. 4, 23-24 (Apr. 9).

[46] Rainbow Warrior Case (New Zealand v. France) 20 R.I.A.A.A. 217, 251(1990).

[47] *Factory at Chorzów* (Germany v. Poland), P.C.I.J. Series A. No. 17. 47 (1928).

[48] Bin Cheng, *Article VI of the 1967 Space Treaty Revisited: "International Responsibility", "National Activities", and "The Appropriate State"*, 26 J. SPACE L. 7, 13-14 (1972).

[49] *Id.* at 15.

[50] *Id.*

[51] *Corfu Channel, supra* note 45, at 22-23.

> In the event of damage being caused elsewhere than on the surface of the earth 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, the latter shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible.

For the purposes of international space law, "the term liability is often used specifically to denote the…obligation to make reparation for any damage caused, especially in the form of monetary payment."[52]

Given this regime, "[s]ervice providers must therefore take out risk coverage and pay insurance premiums, also covering the State's share of international liability; the costs incurred are then transferred to service users."[53] Additionally, an absolute liability standard will be applied to damage caused by a space object on the surface of the Earth or to an aircraft in flight.[54] This is, in fact, where damage is most likely to be caused by a sub-orbital craft, given the limited time (if any) they will spend in proximity to other space objects. It is important to consider, however, that damage caused to the surface of a Launching State or to an aircraft registered therein, will be subject to the laws of that State, rather than the international regime. That said, if they should cause damage to a space object of another State (and both the identity of the space object and cause of the occurrence determined), liability would be allocated on a fault basis.[55] There has been no case law decided on the basis of the international space law treaties.[56] It is worth noting that the Liability Convention has been used only once since its inception: it was referenced by Canada in the diplomatic exchanges resolving the *Cosmos 954* crash in the Northwest

---

[52] Cheng, Bin, "Article VI of the 1967 Space Treaty Revisited: 'International Responsibility', 'National Activities', and 'The Appropriate State'" 26 J. SPACE L. 7, 9-11 (1972).

[53] Sgrosso, *supra* note 7, at 485.

[54] *Liability Convention*, *supra* note 38, art II.

[55] *Id*, art III.

[56] Tanja Masson-Zwaan, *Liability and Insurance for Suborbital Flights,* in PROCEEDINGS OF THE 5TH IAASS CONFERENCE 3 (2009).

Territories, which resulted in a multi-million dollar payment by the USSR to Canada for damages.

Liability under this space law treaty regime is unlimited. Domestic laws can provide for caps or limits for the different parties involved, as well as minimum insurance requirements, thus implying that the State is committed to assume the remainder of the unlimited liability beyond those limits.[57] Insurance can be taken out for an operator's 'peace of mind' or in order to comply with certain national legislation, and can include related organizations or States as coinsured. "The insurance industry can help in managing private investment risks against property, financial and liability losses. The insurers, however, need to make use of particularly careful, anticipatory risk valuations, competent inspectors, and highly specialized know-how in pricing and claims handling."[58] Insurers will create a 'risk map' to assess the severity of a possible occurrence and its probability in order to set the price at which they are willing to accept the risk.[59] Unfortunately for those seeking insurance for space activities, they are generally on the far right of such a map, leading to volatile, reactive, and high insurance rates.[60] For example, in late 2001 Munich Re (a major space insurer) announced a rate increase of 50% for launch insurance and 75% for on-orbit insurance.[61] In a different kind of example, the estimated total damage from the *Columbia* space shuttle tragedy is USD 3 billion,[62] though NASA only received USD 500,000 in claims for property damage.[63] Third party liability insurance is generally relatively inexpensive to acquire, particularly given that governments are sometimes included as joint in-

---

[57] *Id.*

[58] Lovier Schöffski and Andre Georg Wegener, *Risk Management and Insurance Solutions for Space and Satellite Projects*, 24 THE GENEVA PAPERS ON RISK AND INSURANCE. ISSUES AND PRACTICE 203(1999), *citing* P.J. Blassel, *Space Projects and the Coverage of Associated Risks* 10 THE GENEVA PAPERS ON RISK AND INSURANCE. ISSUES AND PRACTICE 36, 51-83 (1985).

[59] Masson-Zwaan, *supra* note 56 at 4.

[60] *Id.* at 5.

[61] Jeff Foust, *Insurance woes may hurt space industry*, SPACEFLIGHTNOW.COM (2001), http://spaceflightnow.com/news/n0111/07insurance/.

[62] Manikowski, *supra* note 7, at 141.

[63] *Id.* at 148.

sureds.[64] As you can see from the *Columbia* example, it is not uncommon for most damage sustained to be first party damage.

E. U.S. Liability & Waivers

Aerospace companies in the U.S. continue to cite commercial enterprises of foreign governments and use of industrial policy to continue to justify the favorable U.S. government-industry risk-sharing regime in U.S. launch law,[65] which includes mandatory cross-waivers of liability, insurance and financial responsibility requirements, and conditional catastrophic indemnification.[66] Liability for space activities is addressed at the national level in the U.S. through the Commercial Space Launch Act.[67] A three-tier liability regime requires that a licensee maintain insurance or be able to self-insure for the Maximum Probable Loss (MPL) up to USD 500 million, adjusted for inflation. MPL calculations have been as low as USD 3 million and as high as USD 268 million.[68] Congress can allocate funds to indemnify the licensee for the amount between the MPL and USD 2 billion (as adjusted for inflation after January 1, 1989), and the licensee will be liable for any amounts in excess of the inflation-adjusted USD 2 billion.[69] Additionally, cross-waivers of liability must be maintained between the licensee and all commercial entities that are involved in the activity, including contractors and subcontractors, as well as between those parties and the U.S. government for amounts in excess of the mandated insurance coverage.[70] According to FAA calcula-

---

[64] Masson-Zwaan, *supra* note 56, at 5.

[65] Joanne Irene Gabrynowicz. *One Half Century and Counting: The Evolution of U.S. National Space Law and Three Long-Term Emerging Issues*, 4 HARV. L. & POL'Y REV. 405, 410-412 (2010).

[66] Michael Mineiro, *Assessing the Risks: Tort Liability and Risk Management in the Event of a Commercial Human Space Flight Vehicle Accident*, 74 J AIR L & COM 371, 392 (2009).

[67] 51 U.S.C. § 50901 (2015).

[68] Schaeffer, *supra* note 17, at 235, 236, 241.

[69] 51 U.S.C. §§ 50914-50915 (2015). As of 2012, the inflation-adjusted amount is approximately $2.7 billion; *Necessary Updates to the Commercial Space Launch Act,* U.S. HOUSE OF REPRESENTATIVES COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY, SUBCOMMITTEE ON SPACE 3 (2014); citing *Testimony before the Science, Space, and Technology Committee,* U.S. GOV'T ACCOUNTABILITY OFF. 5 (2012), http://www.gao.gov/assets/600/591391.pdf>.

[70] 51 U.S.C. §§ 50914-50915 (2015).

tions, there is less than a one in ten million chance of a loss exceeding the required insurance and triggering U.S. government liability.[71]

Until the Commercial Space Launch Competitiveness Act was signed into law in November 2015, the cross-waiver of liability provisions specifically excluded spaceflight participants with regard to the commercial operator, though they required a waiver of liability from the spaceflight participant to the federal government.[72] Under the exclusion, spaceflight participants could potentially sue operators, and operators could sue manufacturers for indemnification of amounts paid to such participants.[73] The 2015 change is effective through 2025, at which point spaceflight participants will once again be excluded unless further legislative action is taken.

Though individual U.S. states cannot have laws inconsistent with federal law, the Commercial Space Launch Act does grant the authority to states to implement supplemental legislation that adds onto or is more stringent than the provisions of the Act.[74] As regulation of the space industry by individual states has not been pre-empted, state and local legislation is permitted to the extent that it does not conflict with federal regulation.[75] Several U.S. states have undertaken legislative activity with the intention to attract space tourism. Such state law incentives include: offering of spaceport incentives intended to leverage existing facilities, establishment of space authorities, creation of favorable tax regimes, and implementation of industry-favorable liability regimes.[76] Virginia pioneered Spaceflight Liability and Immunity Acts for spaceflight participants (or simply "participants" as these acts universally call them) in 2007.[77] Since then, Florida, California, Texas,

---

[71] Schaeffer, *supra* note 17, at 242.

[72] 51 U.S.C. § 50914(b) (2015); 14 C.F.R. § 401(2015); 51 U.S.C. § 50902(21) (2015).

[73] Mineiro, *supra* note 66, at 397.

[74] Commercial Space Launch Activities Act, 51 U.S.C. § 50919 (2010); Mineiro, *supra* note 66, at 381.

[75] Patricia Margaret Sterns & Leslie I. Tennen, *State and Municipal Regulation of the Aerospace Industry in the United States*, in NATIONAL REGULATION OF SPACE ACTIVITIES 467-468 (Ram S. Jakhu ed., 2010).

[76] Gabrynowicz, *supra* note 65, at 420.

[77] Spaceflight Liability and Immunity Act, Va. H.B. 3184, § 8.01-227.8 & § 8.01-227.9 (2007) [hereinafter VA Spaceflight Act].

New Mexico, and Oklahoma have followed suit.[78] Though these acts are preempted for the ten year period between 2015 and 2025 by the Commercial Space Launch Competitiveness Act, they are still on the books and will likely come into play as the space tourism industry grows after 2025. The content of these acts is remarkably similar, though there are a few notable differences of which to be aware. All of the acts specify that, if the procedures of the act are followed, a spaceflight entity will not be liable for a participant injury resulting from the risks of spaceflight activities.[79] Liability waivers are based on the principle of *volenti non fit injuria*; there is no injury to one who consents.[80] A liability waiver is a contract modifying the rights of parties under tort law, and is generally upheld in the U.S. with regard to adventure activities in circumstances where it has been properly drafted and consented to by a participant, though some states will not enforce these contracts on public policy grounds.[81] "[I]t is generally agreed that the liability waiver: (1) must not violate public policy; (2) must have been procured through adequate consideration; (3) must contain clear and unambiguous language; and (4) the signatory must have the capacity to contract."[82] Generally speaking, these waivers cannot include gross negligence or recklessness.[83] Some courts have held such waivers against public policy where a public duty is involved,[84] which would not be the case with regard to space tourism.

These forms, however, are not always accepted or enforceable in other jurisdictions, and thus may not provide a useful model

---

[78] Spaceflight Informed Consent Bill, Fla. S.B. 2438 (2008) [FL Informed Consent]; Spaceflight Liability and Immunity Act, 7 Ca. Civ. Code § 2210 (2012) [CA Spaceflight Act]; Limited Liability for Space Flight Activities Act, 4 Tex. Civ. Prac. Ch. 100A (2011) [TX Spaceflight Act]; Spaceflight Informed Consent Act, N.M. S.B. 240 (2013) [NM Informed Consent]; Spaceflight Liability and Immunity Act, 3 Okla. Stat. § 351 (2013) [OK Spaceflight Act].

[79] VA Spaceflight Act, *supra* note 77; FL Informed Consent, *supra* note 78; CA Spaceflight Act, *supra* note 78; NM Informed Consent, *supra* note 78; OK Spaceflight Act, *supra* note 77.

[80] Suzen M. Grieshop Corrada, *Liability Waivers in the United States Travel and Adventure Sports Industry*, INT'L TRAVEL L. J. 156 (2006).

[81] *Id.* at 156-157.

[82] *I*d. at 157.

[83] *Id.* at 158.

[84] JOHN O. SPENGLER & BRUCE B. HRONEK, LEGAL LIABILITY IN RECREATION, SPORTS, AND TOURISM 69 (2011).

moving forward with regard to the development of national or international space regulation. Waivers are useful in that they "efficiently shift the risk to those participants who are explicitly willing to bear the risk of unforeseeable accidents, and leaves the risk of foreseeable accidents to those (the space flight companies) who are able to take measures to prevent them."[85]

II. SPECIFIC CONSIDERATIONS FOR SUBORBITAL AND HYPERSONIC VEHICLES

A. What are suborbital vehicles and why are they different for insurance purposes?

The development of sub-orbital and hypersonic vehicles for space tourism, scientific research, and ultimately point-to-point transportation, is in its early stages and holds the possibility of great advancements for mankind. It raises some unique legal and regulatory questions, however, given the lack of a specific regime and the difficulty with simply classifying these sorts of vehicles wholesale. Of commercially operated transportation industries, aviation is the most technologically similar to the operation of human spaceflight vehicles.[86]

It is particularly difficult to insure the first five launches of a new launch vehicle.[87] With the large number of entities making a foray into the hypersonic or sub-orbital arena, there are a number of new sub-orbital "launch" vehicles entering the market. Some of these vehicles, however, operate more similarly to aircraft than to a traditional rocket-based space launch vehicle.

"From its very inception, mankind's attempts to overcome the forces of gravity by putting heavier-than-air craft into flight have been fraught with a very high level of risk."[88] For an airline, in-

---

[85] Christopher D. Johnson, *The Texas space flight liability act and efficient regulations for the private commercial space flight era*, 92 ACTA ASTRONAUTICA 226, 233 (2013).

[86] Mariagrazia Spada, *Human Spaceflights Will Extend Regulatory and Legal Framework Governing Civil Aviation*, in Proceedings of the IEEE Aerosapce Conference 2 (2006), http://ieeexplore.ieee.org/document/1655735/.

[87] Jeff Foust, *Insurance woes may hurt space industry*, SPACEFLIGHTNOW.COM (2001), http://spaceflightnow.com/news/n0111/07insurance/.

[88] YAW OTU MANKATA NYAMPONG, INSURING THE AIR TRANSPORT INDUSTRY AGAINST AVIATION WAR AND TERRORISM RISKS AND ALLIED PERILS 17 (2013).

surance costs are typically less than 2% of annual budget,[89] while an average launch plus one year policy on a space object would cost approximately 15% of the insured sum.[90] Aviation rates are around 0.5%, whereas rates are more like 10% for space coverage[91] (not taking into account the 'plus one year').

Types of spaceplanes can include: supersonic spaceplanes, hybrid aerospace systems that can both function on rocket engines like a spacecraft and on more traditional aircraft engines depending on phase of flight, and multistage aerospace planes with aircraft that launch the space vehicles.[92] "[A]eronautics principles and aircraft jet propulsion are the safest and more reliable solutions to timely reach the outer fringes of air space" which also benefit from proven and experienced technologies.[93]

> In suborbital space tourism, the hybrid activities and the lack of legal framework make it difficult for the sector to apply standard rules for aviation or space insurance. The full range of risks has not yet been identified. Moreover, standards, policies, liability, insurance and procedures to minimize and cover risks, still have to be developed. It has also been a very difficult task for underwriters to work out solutions for this new market. Design and equipment of suborbital vehicles are not yet technologically mature enough to achieve reasonable reliability and commercial sustainability.[94]

It is difficult for both primary and reinsurers to devise an insurance program that is both reasonably calculable for the insurer and affordable to the insured, given the constantly changing landscape of technological developments, the small number of insurable events, the relatively high loss occurrence, and the high limits reflecting potentially large losses.[95] With the small number of test flights yet achieved, the statistical risk is challenging to assess

---

[89] *Id,* at 39-40.

[90] Sgrosso, *supra* note 8, at 474.

[91] Tanja Masson-Zwaan, *supra* note 56, at 6.

[92] Sgrosso, *supra* note 8, at 280-289.

[93] Denis Bensoussan, *Space tourism risks: A space insurance perspective*, 66 ACTA ASTRONAUTICA 1633,1635 (2010).

[94] Ana Cristina van Oijhuizen Galhego Rosa, *Aviation or space policy: New challenges for the insurance sector to private human access to space*, 92 ACTA ASTRONAUTICA 235 (2013).

[95] Schöffski and Wegener, *supra* note 58, at 209.

and this difficulty can lead to higher premiums and lower capacity in short term.[96] The ambiguity premium charged to account for unpredictability resulting from the insurer ambiguity in rating these sorts of risks adds to the cost of obtaining insurance.[97] One substantial problem in comparing suborbital or hypersonic transportation to aviation is the stark difference in reliability statistics between space and aviation activities: passenger space travel endeavors are targeted to one fatal accident per 50,000 flights, while civil airliner reliability statistics are at least as good as one in two million.[98]

> There is a consensus among operators, brokers and the insurance markets that maiden 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…[99]

In order to acquire financing, the operator would often need to have an insurance policy already in place, which would be remarkably difficult to obtain given the technological uncertainty at that stage.[100] This creates another substantial hurdle in order to enter the suborbital or hypersonic market.

Defining the insurable risks is the most difficult task, given the complexity of the activity. Some of the factors include: the variety of actors, risks, and phases; the potential property damage both on Earth and in space; and the variety of insurance markets involved (which can include aviation, space, and marine).[101] In an insurance policy, "Hull" would refer to all the equipment integrated into the vehicle, including of course the hull itself, as well as electronics and machinery.[102] It consists of all risks of physical loss or damage to the craft except loss of use, delay, consequential loss, wear and tear, mechanical breakdown, war, strikes, riots,

---

[96] Rosa, *supra* note 94, at 238.
[97] Nyampong, *supra* note 88, at 54.
[98] Bensoussan, *supra* note 93, at 1637.
[99] *Id.* at 1637-1638.
[100] Schöffski and Wegener, *supra* note 58, at 210.
[101] Rosa, *supra* note 94, at 236.
[102] Bensoussan, *supra* note 93, at 1635.

civil commotion, or radiation.[103] In terms of the lead vehicle (for example, Virgin Galactic's *WhiteKnight*), would the hull risk be considered an aviation risk or a space risk?[104]

In addition, some significant differences between jet propulsion and suborbital craft are propulsion mode, re-entry technology, redundancy scheme, safety devices, vehicle handling, and procedures for ground maintenance.[105]

> *Before the separation,* the combined aircraft/space vehicle has the characteristics of an aircraft in terms of technical functions, flight pattern and maneuverability. While connected, it also derives support in the atmosphere from the reactions of the air.
>
> *After the separation,* the space vehicle does not satisfy the criteria of the above-mentioned definition of an aircraft. Once the space vehicle is separated from the aircraft, it is being launched vertically like a rocket and does not derive support in the atmosphere.[106]

In terms of similarities, though, aviation insurance also lacks the substantially large number of insureds to benefit from the Law of Large Numbers, a structure utilizing actuarial principles based on data from the full range of past experiences.[107] Granted, the smaller numbers available with regard to space activities is even more striking than with regard to aviation. That said, the space insurance market currently possesses a narrower range of risk coverage as compared to aviation insurance, which would potentially be able to govern a market for suborbital space tourism given the lack of an otherwise applicable regime for this activity.[108]

---

[103] *Id.* at 1635.

[104] *Id.* at 1634.

[105] *Id.* at 1635.

[106] Rosa, *supra* note 94, at 238 *citing* Stephan Hobe, *Future High-Altitude Flight – An Attractive Commercial Nice, Scenario 2 – Air Launch*, FLACON PROJECT REPORT 4 (2007).

[107] Nyampong, *supra* note 88, at 22, 42. The number of insured aircraft worldwide is similar to the number of vehicles registered in any medium-sized North American or European city.

[108] Rosa, *supra* note 94, at 240.

B. Liability in Air Law

While Part I. Section D. provides an overview of liability in space law, this section provides a discussion of private international air law liability rules, including the Warsaw Convention and Montreal Convention and protocols. It is important to note that national law governs national flights, which would therefore also be the case for suborbital travel.[109]

The 1929 Warsaw Convention, with 152 States Parties, revolutionized liability for commercial aviation.[110] Fundamentally, the Convention instituted a reversal of the burden of proof,[111] allowing the burgeoning industry freedom to grow with a less oppressive liability regime for international air travel. Liability was limited for damage to persons, cargo, or luggage, except insofar as willful misconduct or the equivalent thereof could be proven.[112] Thus, litigation with regard to this Convention largely centered on whether or not the liability limits could be breached.

Subsequently, the Montreal Convention modernized the regime created by Warsaw. This Convention, which entered into force in 2003, now has 111 parties.[113] It effectively removes the liability cap for passenger death or injury, limiting liability only if the carrier can prove they have not been negligent.[114] The movement from a limited to unlimited liability scheme in aviation followed on from developments in the law of the sea.[115] When the industry matured, the balance was shifted in favor of the consumer.[116] "It was considered that unlimited liability actually encourages parties to settle their disputes, instead of going to court arguing for or against willful misconduct, trying to break the limits

---

[109] Masson-Zwaan, *supra* note 56, at 2.

[110] The Convention for the Unification of Certain Rules Relating to International Carriage by Air, Oct. 12, 1929, ICAO Doc. 7838, 9201, 137 L.N.T.S. 11 (1933), 49 Stat 3000 (1929).

[111] *Id.*

[112] *Id.* art 22, 25.

[113] The Convention for the Unification of Certain Rules for International Carriage by Air, May 28, 1999, ICAO Doc 9740 [hereinafter Montreal Convention].

[114] *Id.* art 21.

[115] Masson-Zwaan, *supra* note 56, at 2.

[116] *Id.*

imposed under the Warsaw system."[117] Thus, there are reasons to favor either a limited or unlimited liability regime.

The Rome Convention sets forth a liability regime for damage to third parties (neither the carrier nor those in contract with the carrier) resulting from the operation of aircraft. This Convention limits liability on the basis of aircraft weight.[118] Unfortunately, largely due to issues with adjusting the liability caps for inflation, the Rome Convention has only 49 parties,[119] and is missing significant aviation players like the United States.[119] The General Risks Convention is an attempt to modernize the Rome regime in a form that will be more acceptable to a greater number of States. It caps strict liability for the carrier also based on aircraft weight, but like the Montreal Convention, it only applies if the operator can prove it was not negligent. It has not yet obtained sufficient ratification to enter into force.[120]

While the Warsaw Convention does not require compulsory insurance, the Montreal Convention does.[121] Compulsory insurance tends to focus on second and third party losses, and thus fails to address first party losses that can be sustained by a carrier.[122] Under the Rome Convention, a State can require a foreign operator to carry insurance for damage that could be caused in the State's territory and which would be addressed by the Convention, but it is possible for a guarantee to be given by the contracting State of registration that it will not claim immunity from a suit, in lieu of requiring that the carrier acquire insurance.[123] The General Risks Convention, which has yet to enter into force, would provide for strict liability for third-party damage (due to death, bodily injury, mental injury, and property damage) to an aircraft opera-

---

[117] *Id.*

[118] Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface, Art. 11, Oct. 7,1952, 310 U.N.T.S. 182 [hereinafter Rome Convention].

[119] Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface, signed at Rome on 7 October 1952, ICAO, http://www.icao.int/secretariat/legal/List%20of%20Parties/Rome1952_EN.pdf.

[119] *Id.*

[120] Convention on Compensation for Damage Caused by Aircraft to Third Parties, Art. 4, May 2, 2009, ICAO Doc 9199 [hereinafter General Risks Convention].

[121] *Montreal Convention*, *supra* note 113, art. 50.

[122] Nyampong, *supra* note 88, at 59.

[123] *Rome Convention*, *supra* note 118, art. 15(c).

tor.[124] This convention also requires insurance or a guarantee of ability to cover liability, and can be required to produce proof thereof.[125]

The hazardous nature of space activities is clear, and on that basis, State responsibility and liability for damage caused by space objects is reasonable and possibly desirable. That said, limiting the liability of operators both reduces the financial barriers to entry into the space arena, and reduces the cost of insurance necessary to safeguard companies from potential financial ruin in the case of damage. From this perspective, limiting liability for suborbital or hypersonic operators, who are largely operating in airspace, could substantially improve the viability of the industry.

C. Safety in Air Law and the Chicago Convention

The International Civil Aviation Organization (ICAO), in accordance with the Chicago Convention, promulgates safety standards for international civil aviation.[126] Article 44 of the Chicago Convention calls upon ICAO to ensure safe, regular, efficient, and economical air transport.[127] Article 37 provides a commitment to collaborate to obtain uniformity in areas which will improve or facilitate air navigation.[128] "International air transport operates within an extremely complex legal network that is based on air services agreements between national governments and on rules and regulations made by the ICAO…and IATA (International Air Transport Association)."[129]

Annex I to the Chicago Convention defines aircraft as follows: "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." This would inherently rule out craft that are only rocket powered and do not have glider capabilities (because a traditional rocket-powered craft cannot derive any support from the air – reactions against the Earth's surface are irrelevant in this

---

[124] *General Risks Convention*, *supra* note 120, art. 3.

[125] *Id.* at art. 9.

[126] Convention on International Civil Aviation, Dec. 7, 1944, 61 Stat. 1180, 15 U.N.T.S. 295.

[127] *Id.* at art 44.

[128] *Id.* at art 37.

[129] Spada, *supra* note 86, at 1.

analysis), but could include many, if not most of the hybrid aerospace vehicles under development today. (It is worth noting that the term "space object" is not specifically defined in any of the relevant space conventions.) While attempting to suddenly implement the strict licensing, technical, and other safety guidelines on space endeavors would be unnecessarily burdensome on the industry; it would be possible to create a similar safety regime specifically applicable to this manner of suborbital or hypersonic craft, thereby increasing risk management and reducing premium.

With sufficient development and testing, it may even be possible to apply some of the Chicago Convention annexes to these activities without significant modification. For reference, the existing annexes to the Chicago Convention regulate the following: personnel licensing, rules of the air, meteorological service for international air navigation, aeronautical charts, units of measurement to be used in air and ground operations, operation of aircraft, aircraft nationality and registration marks, airworthiness of aircraft, facilitation, aeronautical telecommunications, air traffic services, search and rescue, aircraft accident and incident investigation, aerodromes, aeronautical information services, environmental protection, security to safeguard international civil aviation against acts of unlawful interference, the safe transport of dangerous goods by air, and safety management.

In general, "the obligation to maintain air navigation and communication systems/services may extend beyond the territory of the contracting States proper and well into the territory of neighboring States without necessarily violating the sovereign rights of the other State."[130] This overlap in services can help to ensure safety of both aviation and space operators who may be utilizing the airspace of a region, and combining services particularly for aviation and suborbital or hypersonic travel produces benefits in terms of safety and risk management, as well as efficient operation of air space.

With regard to space, "[s]afety procedures and devices could range from traditional cabin pressurisation and protection, g-constrained trajectories to more innovative concepts like pressure suits, helmets, internal and external airbags, ejection capsule and

---

[130] *Id.* at 3.

parachutes."[131] Generally, one effective way to further develop space travel passenger services would be through substantial collaboration with the aviation industry, which would help to improve their commercial viability.[132] The aviation industry has a time-tested understanding of safety standards and best practices that can lay the groundwork for similar standards with regard to space. "Accepted levels of vehicle safety and public risk will be identified for commercial space vehicles. Based on these safety and risk levels, some space vehicles will be evaluated for safety in a manner similar to that performed for commercial aircraft."[133] When standards are applied to space travel in the manner they are applied to aviation, it should serve to lower insurance premiums due to increased confidence in the industry and risk management on the front end.

D. Aviation Insurance

Now that private international liability law and public international safety rules have been discussed with regard to the aviation side of the house, it is possible to compare aviation insurance to space insurance under the relevant space legal regimes. In order to assess the applicability of aviation insurance to suborbital and hypersonic activities, it is necessary to define the term. "Although a formal definition of aviation insurance is elusive, the phrase generally refers to the insurance of risks associated with the manufacture, ownership, leasing, operation and maintenance of aircraft, as well as the operation of aviation facilities on the surface of the earth and in outer space in the not too distant future."[134] In fact, even "satellite operations are considered by insurers to be of an aviation nature[.]"[135]

It is also important to assess the purpose of such insurance. "Insurance coverage in the air transport industry carries the same objective as space insurance in that risk management is the over-

---

[131] Bensoussan, *supra* note 93, at 1637.

[132] Spada, *supra* note 86 at 3, *citing* P. Collins & Y. Funatsu, *Collaboration with Aviation- The Key to Commercialization of Space Activities*, SPACEFUTURE.COM (2000), http://spacefuture.com/archive/collaboration_with_aviation_the_key_to_commercialisation_of_space_activities.shtml.

[133] Spada, *supra* note 86, at 6.

[134] Nyampong, *supra* note 88, at 39.

[135] Margo, *supra* note 1, at 565.

arching purpose of insurance contract. A risk entails four possible responses from the person at risk: acceptance, elimination, reduction, and transfer."[136] Aviation insurers use a variety of risk rating factors to set rates for third party insurance, including: geographical area of operation, essential nature of the product or service being insured, the jurisdiction, the type of aircraft, local turnover volume, quality control system and procedures, contractual terms, prior claims, and market conditions.[137] Meanwhile, rates for passenger insurance are determined by factors such as the type of aircraft, flight duration, liability regime, and so forth.[138]

"Similar to most commercial air transport insurance contracts, the space insurance policy is usually underwritten in syndicate where each individual underwriter assumes a percentage of the risk."[139] Also, similarly to commercial aviation insurance, the only types of losses that will be typically excluded from coverage under a launch policy would be those resulting from war, ASAT weapons, confiscation, radioactive material, electromagnetic or radiofrequency interference, and intent.[140]

III. RECOMMENDATIONS AND CONCLUDING THOUGHTS

Some have suggested that longer-term or higher government indemnification caps provided by the U.S. government would serve to foster the development of the U.S. commercial space industry. However, "there is no indication from the insurance industry that rates would be significantly impacted by the US government agreeing to take on additional third party liability for a prolonged period of time."[141] Given the low probability of triggering the existing government indemnification limits cited by the FAA,[142] this change seems it would be an unnecessary one to strive for where other reforms are so critically needed. Modifications to export control regimes that impact the ability to shop for insurance and to provide sensitive technical data to insurers are a

---

[136] Abeyratne, *supra* note 10, at 199-200, citing Rod D. Margo, *Risk Management and Insurance*, 17 ANNALS AIR & SPACE L. 59, 80 (1992).

[137] Masson-Zwaan, *supra* note 56, at 4.

[138] *Id.*

[139] Abeyratne, *supra* note 10, at 191.

[140] Schöffski and Wegener, *supra* note 58, at 205.

[141] Schaeffer, *supra* note 17, at 240.

[142] See text accompanying FN 71.

much higher priority with regard to legal impediments in the insurance and liability regime. Export control regulations are only effective when States cannot obtain the restricted supplies from third States;[143] when they can, the intended purpose of said restrictions is eroded, as is the relevant national industry. In this case, those individuals, entities, and States wishing to procure technologies with restrictive or complicated export controls from the U.S., can turn to other technologically advanced or launch-capable States, rendering the U.S. export controls ineffective and counter-productive to the national space industry.

Though this article has focused on issues of space law (and to a lesser degree, air law), it is not to be forgotten that there is a large body of well-developed insurance law that likewise applies to the space insurance industry and will be applied in the case of contractual disputes surrounding a contract for space insurance. To that end, there is an opportunity to echo a series of insurance recommendations made by Stephen Tucker over twenty years ago that are still relevant today. Simply put, imprecise or ambiguous language is to be avoided, proof of loss requirements must be understood and adhered to by insureds, insureds should focus efforts to mitigate any losses that would be covered under the policy, and insureds must update the insurer with any information pertinent to the policy through its life.[144]

For suborbital and hypersonic flights, it is possible that three types of insurance (first, second, and third party risks) could be handled differently from each other.

> Insurance for operators' liability vis-à-vis passengers (second-party liability) will likely be placed on the aviation market, which has vast experience in this field, of course with necessary adaptations. Insurance for operators' liability vis-à-vis third parties could be placed on either the space or the aviation insurance market, as both markets have experience and capacity in this field. Similarly, hull risks and personal accident insurance will be developed, using the experience of both markets…[145]

---

[143] Creydt and Horl, *supra* note 29, at 291.

[144] Tucker, *supra* note 19, at 139.

[145] Masson-Zwaan, *supra* note 56, at 7.

It would be logical to provide passenger insurance in a framework similar to that of aviation, given the similarities in carriage, albeit at an appropriate rate for space travel rather than air travel.

The insurance concerns of this unique area bridge both space and aviation, with elements of both fields. Certain innovations, such as annual rather than per-flight hull insurance, are critical to the success of the industry, and only make sense, given the fact that the spacecraft in question are reusable, unlike their expendable counterparts, which are sensibly insured for their only flights.

> [R]ealistically suborbital space tourism needs to have an insurance premium of less than 1%, or the costs to fly needs to increase. The hull of the aircraft will be insured on an annual basis rather than on a per-flight basis. Commercial satellites launches are insured on a single, per-launch basis, for which rates are approximately 10% of the insured value. As a result, from the economic viewpoint there is very little interest from the space insurance sector in insuring space tourism, because the revenue is likely to be minimal…Underwriting the hull of the rocket through the aviation markets will result in far lower premium rates for the risk than if the risk were underwritten through the space insurance market.[146]

Given the financial considerations, it would be almost absurd to provide insurance for a suborbital reusable horizontal take-off and landing craft in the same manner as one would provide insurance for a vertical take-off expendable rocket.

The provision of insurance is essential, regardless of whether we term suborbital and hypersonic flights as space, aviation, or some form of hybrid aerospace activity. With regard to both space and aviation activities,

> states can be called upon to be responsible for ensuring that both these critical areas are covered for risks so that continuity of the services they render are assured…both industries are 'brittle' and, therefore, susceptible to catalysts of market failure…States should play the role of initiator and regular of

---

[146] Rosa, *supra* note 94, at 240 *quoting* that author's interviews with Neil Stevens, legal counsel of the Atrium Space Insurance Consortium (15, 19, 21, 26 & 29 July 2010).

> insurance to the extent of ensuring that insurance is available rather than actually providing it.[147]

Finally, the ability to leverage communication, navigation, surveillance, and decision support systems is key to creating a modernized airspace system; the integration of space and aviation operations will be key to ensuring the provision of efficient service to all users.[148] Thus, a liability and insurance regime that is supportive of this integration is essential to the safe operation of both aviation and suborbital activities. It is up to the States, both individually and in cooperation, to provide a regulatory environment that makes space insurable.

Though this article has not focused extensively on issues of safety, it has addressed liability waivers that are in place in the U.S., in addition to its main focus, which has been liability insurance. "It should become evident that neither waivers of liability nor liability insurance policies taken out…neither wholly negate nor fundamentally disrupt the calculations that space flight entities should take in deciding how to evaluate risk and safety."[149] It is in the best interests of spaceflight entities, as rational actors, to ensure a reasonable degree of safety, even where such options as waivers and insurance exist. The idea that the availability of such tools will inherently or automatically create a moral hazard that would lead to the erosion of safety standards is flawed.

To conclude, it is critical to note that commercial entities will generally prefer legal frameworks that provide the greatest degree of legal certainty, leaving less for the courts to decide if a dispute should arise[150] and therefore protecting their investments. Thus, for both insurers and regulators, legal certainty (stopping short of over-regulation) is a laudable goal.

---

147 Abeyratne, *supra* note 10, at 209-210.

148 Spada, *supra* note 86, at 2.

149 Johnson, *supra* note 85, at 233.

150 Michael Gerhard and Kamlesh Gungaphul-Brocard, *The Impact of National Space Legislation on Space Industry Contracts*, in CONTRACTING FOR SPACE 63-64 (Lesley Jane Smith & Ingo Baumann, eds. 2012).