Governing Activities in Outer Space: Responsibility, Liability, Regulation and the Role of Insurers

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Abstract

As we have seen from the numerous high profile launch failures and accidents that have occurred between 2014 and 2016, space activities are still ultra-hazardous in nature, despite sixty-plus years of technological development. These activities range from essential to modern life (ex., telecommunications) to futuristic and forward thinking (ex., space tourism). In order for these activities to not only continue, but also develop and grow, this inherent risk must be managed.

Further complicating the risk dynamic in outer space, States are required to take liability and responsibility for the activities of their nationals in space, including private entities and individuals. The reality of this relationship is that while States wish to promote the development of their domestic space industries, they will also usually require certain levels of insurance and indemnification to protect the State against potentially costly mishaps.

With regard to outer space, political will is lacking at an international level to create new binding rules for activities in space. Likewise, States are reluctant to unilaterally impose stricter (even if ultimately beneficial) regulations on their entities for fear that their domestic industries will flee abroad to greener pastures, creating a regulatory prisoner's dilemma.

These factors create a scenario where the major space insurers responsible for writing policies across national boundaries may be uniquely positioned to enforce or at least promote mechanisms to increase safety and sustainability in the commercial

space industry. Increasing safety and sustainability in outer space may help to keep premium costs from growing out of control for these hazardous activities, as well.

Thus, this thesis addresses three fundamental questions:

- From a legal and policy perspective, is there a regulatory void that needs to be filled, at least temporarily?
- Are insurance companies in a position to be able to fill or partially fill that void?
- If so, how, and what actions can they undertake to improve their ability to execute that governance function?

In answering these questions, this manuscript-based thesis explores the existing body of space law and common practices in space activities, including notable lacunae, and applies theories of "insurance as governance." This approach permits both analysis of the existing status of the industry and recommendations to increase the viability of space activities moving forward.

Resumé

Malgré les 60+ années de développement technologique, les activités spatiales sont toujours de nature ultra-dangereuse, comme l`ont fait preuve les nombreux échecs de lancement d`haut profile entre les années 2014-2016. Ces activités rangent de ces qui sont essentielles pour la vie moderne (par exemple, les télécommunications), jusqu`à ces qui sont plus avant-gardes (voir tourisme spatial). Afin que ces activités seront non seulement continués, mais aussi développées et augmentées, on doit administrer leurs danger inhérent.

Les états sont obligés de retenir responsabilité pour les activités nationaux dans l`espace, y compris les activités des entités privées et celles des individus, un fait qui rends la dynamique du danger dans l`espace encore plus compliqué. La réalité de cette situation est que pendant les états veulent promouvoir le développement de leur propre industrie spatiale, ils exigent néanmoins certaines niveaux d`assurance et indemnisation afin d`être protégés contre accidents probablement chers.

En ce qui concerne l`espace, la volonté politique n`existe pas afin de créer des nouvelles instruments pour les activités spatiales. En même temps, les états ne veulent pas imposer des normes unilatérales plus strictes (même si elles sont nécessaires en longue terme) à leurs propres entités, ayants peur que leurs industries domestiques déménageront aux autres juridictions ; véritablement un « prisoner`s dilemma » normatif.

On se trouve alors devant un scénario où les grands assureurs spatiaux qui écrivent des politiques trans-bordereaux peut-être sont dans la position unique d`enforcir ou au moins promouvoir des mécanismes qui augmentent la sécurité et la viabilité de l`industrie commerciale spatiale. En augmentant la sécurité et la viabilité dans l`espace

extra-atmosphérique on peut aussi maintenir les coûts de premium pour ces activités dangereuses aux niveaux bas.

Ainsi, cette thèse adresse trois questions fondamentales :

- D'un point de vue juridique et en ce qui concerne la politique applicable, existe-t-il un vide réglementaire qui doit être comblé, au moins temporairement?
- Les compagnies d'assurance sont-elles capables de combler ou de combler partiellement ce vide?
- Si la réponse est affirmative, comment vont-elles le faire, et quelles actions peuvent-elles entreprendre pour améliorer leur capacité à exécuter cette fonction de gouvernance?

En répondant à ces questions, cette thèse analyse le corps existant de droit spatial et les pratiques communes dans les activités spatiales, y compris des lacunae prononcés, et applique des théories de « assurance comme de gouvernance ». Cette approche permet d`analyser tout en même temps le statut contemporain de l`industrie et des recommandations pour accroître la viabilité des activités spatiales futures.

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My fellow faculty members at the University of Mississippi have provided helpful encouragement and general structural feedback as part of our Faculty Writing Groups this year, and I have appreciated being able to use our Faculty Writing Retreat toward the completion of this thesis. Thank you also to my program director, Jacqueline Serrao and to Senior Associate Dean for Faculty Development Jack Nowlin, who have been supportive of my progress toward completing my degree.

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It is also necessary to acknowledge Professor Thomas Morawetz from the University of Connecticut School of Law for his tireless encouragement and advice, without whom I would likely not be at McGill.

Finally, I must mention my parents for their unwavering faith and support and also my first beagle, Harvey, a constant companion and welcome distraction, who has now been joined his new beagle companion, Dutch.

Preface

While there is a well-recognized lack of will to (over)regulate the space industry for fear of stunting the growth of this highly risky sector, I argue that it is helpful and, indeed in the long term, necessary to provide oversight and regulation in this field, both for legal (under the international space law regime) and policy reasons. The primary purpose of this thesis is to provide an innovative approach to governance of the space industry: insurer mandated and incentivized standards acting as regulations to protect the sustainability and financial viability of the industry moving forward. While I recognize that this method may be less effective than carefully implemented governmental regulation, I argue that it can serve a promising stopgap function in the interim, and indeed assist to develop the standards that will later be implemented in governmental regulations. By, for the first time in space law, using a comprehensive "insurance as governance" theoretical approach that has slowly emerged over the last two decades and by critically analyzing the unique legal and policy implications in international space law and U.S. domestic space law, this thesis provides guidance to academics, space entrepreneurs, and insurers to assist in the continuing development of this industry. Notably, this thesis provides a unique case study, comparing the development of steam boiler insurance to possibilities that may be available for the development of the space insurance industry. Additionally, this thesis utilizes the author's experience in drafting insurance contracts to critically analyze particular aspects of contract language interpretation and parts of an insurance contract in light of their importance as instruments of "governance." This thesis also briefly addresses opportunities that may be available to combine or supplement space insurance policies with other forms of insurance to increase affordability and industry viability, as well as to solidify the relationship between insurer and insured. As required, a comprehensive literature review has been included, and has been woven throughout this thesis along with analysis of the literature and argumentation based on my findings from my review. The breadth and depth of sources reviewed and utilized can be ascertained from my bibliography and use of footnotes.

As this thesis has been produced as a manuscript-based thesis, this preface contains a description of those projects that have contributed to its development. In the process of combining these elements into a coherent document, the individual manuscripts have been morphed into one larger document, and is substantially different in many ways from its individual component parts. Some parts of the thesis have been published, while others that have been developed more recently and/or more specifically to bring the document together have not.

Nearly one full chapter of this thesis was produced as *The Definition and Delimitation of Outer Space* in the Annals of Air and Space Law Volume XXXIX (2014), originally written upon request from the International Association for the Advancement of Space Safety to be presented at the UNCOPUOS Legal Subcommittee. Editorial assistance on this chapter was provided by: Prof. Ram S. Jakhu, Prof. Paul Dempsey, Dr. Yaw Nyampong, Mr. Tommaso Sgobba, Dr. Joseph Pelton and Prof. Sa'id Mosteshar, though I served as the only author; I have given several presentations regarding the results of this research. I was also the only author of *Legal Considerations for Commercial Space: An Overview in New Space Volume 3: Issue 2 (2015),* which has been adapted for inclusion in this thesis. A chapter entitled *State Spaceflight Liability and Immunity Acts in Context* in The Governance of Emerging Space Activities: Legal and Policy Perspectives, Leuven Global Governance Series, Edward Elgar Publishers is currently awaiting publication, and served as the basis for the relevant sections of this thesis. It was based on a presentation I gave at the Legal and Policy Aspects of Commercial use of Space, incl. Space Tourism conference (Leuven, Belgium) September 2013. Once again, I was the only author. I utilized the opportunities to write several conference papers as the sole author which also play a role in this manuscript-based thesis: *Risk Management in the Intermediate Frontier*, 3rd Manfred Lachs International Conference on NewSpace Commercialization and the Law (Montreal) March 2015, *Leveraging Insurance for Commercial Space: Managing Legal and Regulatory Challenges*, 31st Space Symposium (Colorado Springs) April 2015; *Debris Mitigation as an Insurance Imperative,* IAC (Jerusalem) October 2015; *Insurers as Regulators of Space Safety and Sustainability,* FAA Commercial Space Transportation Center of Excellence Annual Technical Meeting (Washington, D.C.) October 2015; *Innovations for Insurers in Space Traffic Management and Weather Forecasting,* Space Traffic Management (Daytona Beach, FL) November 2015; *The Role of Sovereignty in Remote Sensing and Customary International Law,* International Astronautical Congress (Guadalajara) September 2016. An article incorporating elements of several conference papers, entitled *Legal And Regulatory Challenges To Leveraging Insurance For Commercial Space* (solely authored by me), is slated to be published in a forthcoming volume of the Journal of Space Law. The only publication that is a collaborative work that factors into this thesis is an article that I co-authored with Ram Jakhu and Diane Howard for Private Law, Public Law, Metalaw and Public Policy in Space: A Liber Amicorum in Honor of Ernst Fasan. As this was a piece specifically on the topic of space based solar power, it only plays a very minimal role in this thesis (regarding innovative space technologies and their legal, regulatory, and insurance challenges). The research behind this work only comprises less than four total pages of this thesis (the original published article is thirty-four pages in length). For the purpose of this thesis, I have focused on the portion of the text that I drafted and carefully verified and independently analyzed any additional research utilized that was provided by my co-authors. I also solely delivered the presentation of this paper at the Solar Power Satellites conference in Kobe, Japan in 2014.

Of course, my space law research has been built on a foundation that began with my coursework and research in the LLM program and my participation the Manfred Lachs Space Law Moot Court Competition. I thank Ram Jakhu and Jiefang Huang for providing a solid foundation through their teaching and reading assignments, as well as my moot court coach and team members (Isavella Vasilogeorgi, Sarah Mountin, Charles Stotler), as we cooperatively learned to hone our space law research skills and produced a foundational set of research upon which to build. My supervisor and other committee members Professors Ram Jakhu, Paul Dempsey, and Genevieve Saumier have all provided specific comments and recommendations in the editing of this thesis. The Faculty Writing Group at the University of Mississippi Law School, of which I am a member, provided some basic structural and organizational advice on the presentation of the thesis as a coherent document.

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Chapter 1: Introduction

Introduction to the Research Question

As we have seen from the numerous high profile launch failures and accidents that have occurred between 2014 and 2016, space activities are still ultra-hazardous in nature, despite 60+ years of technological development. These activities range from essential to modern life (ex., telecommunications) to futuristic and forward thinking (ex., space tourism). In order for these activities to not only continue, but also develop and grow, this inherent risk must be managed. This risk can be managed through policies, laws, and regulations implemented at the State level to balance the interests of the State. The risk can also be managed by purchasing insurance to cover potential losses. This thesis proposes that insurers are well-poised to be able to provide a meaningful contribution to the governance of space activities, and indeed that they inherently contribute to such governance both by deciding who they will insure and under what terms and conditions they will insure them.

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 our hypothetical private entity: insurance. 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 those private entities seeking insurance, but also the industry itself. Further detail regarding the importance of the insurance market to the space industry can be found in both the History section of this chapter and in Chapter 3: The State of Space Insurance.

Additionally, one means to encourage this industry that has not been fully explored in the literature is management of risk through insurance-based standards, rather than governmentally imposed standards. Thus, the purpose of this thesis is to answer the following research prompt, made up of three subquestions. Given the reluctance of States to provide sufficient regulations in the space arena, particularly for emerging technologies:

1) From a legal and policy perspective, is there a regulatory void that needs to be filled, at least temporarily?
2) Are insurance companies in a position to be able to fill or partially fill that void?
3) If so, how, and what actions can they undertake to improve their ability to execute that governance function?

These research questions are important due to a variety of factors. The first factor is the difficulty with the progressive development of the international space law regime; namely, the dormancy of the Moon Agreement and failure to develop further treaty law in its wake, and the lack of clarity surrounding the applicability of *soft law* instruments (discussed in further detail in Chapter 4). The second factor is the fear of stymying domestic space industries through overregulation that exists at a domestic level, limiting the extent of regulation on which States are willing to take the lead. The third factor is the inherently high-risk nature of space activities, resulting in relatively high costs for space insurance. Factor three presupposes that society has deemed space activities worthy of the risk they entail generally, and this supposition is reviewed in Chapter 2.

This thesis is a helpful guide for academics and practitioners in the space, legal, insurance, and political science fields, but most specifically to those involved directly in the space-related or near-space-related arena. The goal of this thesis is to encourage participants in space activities to think meaningfully about the role insurance has to play in the sustainable development of the industry. If regulators and insurers in particular are conscientious of the role that insurers can and do play in the industry (rather than unaware or uninterested), the outcomes are likely to be improved for all involved. One particular area where this author hopes to generate ongoing conversation is the protection of the space environment from excessive man-made space debris that can threaten the viability of continuing and developing space activities in the future.

Methodology Overview

While each stage of this analysis requires a different set of methodological tools (applied in more specific detail in the below outline of the thesis), the methodology employed in its development is fundamentally doctrinal research with a normative character. The doctrinal analysis identifies what the laws are and applies them to the circumstances discussed throughout this thesis, which also inherently includes discovering gaps in the relevant laws and regulations. The doctrine included from an international perspective includes all three sources of international law as articulated in the ICJ statute, namely: treaties, customary law, and general principles of law. Judicial decisions/writings of highly qualified publicists, which serve as subsidiary means for the determination of rules of law, overlap with the literature review, given the nature of public international law. The domestic analysis includes national laws, regulations, and jurisprudence with relevant literature review to supplement the analysis of these doctrinal elements. This analysis enables answering subquestion one and assists in answering subquestions two and three.

Subquestions two and three additionally require the application of a socio-legal approach with comparative elements. Employing each of these methods permit the development of normative recommendations that can be applied to future reform and development of space law and policy. One notable comparative element employed in this thesis is the case study of the Hartford Steam Boiler Insurance Company (HSB), which led the charge in raising safety standards for the operation of steam boilers in the 1800s, ahead of sufficient government regulation. Though the comparison may be surprising, it is highly relevant: both technologies were notably hazardous in their time periods and resulted in a relatively high rate of accidents (and damage). HSB provided a remarkable contribution in governing the use of steam boilers ; their standards were eventually the basis for regulations at a government level.

Given that the three research subquestions intertwine, the below outline should assist the reader in identifying the role each question plays in each chapter.

History

The "space insurance industry" emerged as a separate field of insurance in 1965. 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 period from late 2014 to present has seen a number of high publicity failures in the space sector that have demonstrated the continuing high risk involved in space activities. The first such failure was the Orbital Sciences resupply rocket meant for the International Space Station that exploded during launch.[1] The second fell a mere few days later on Halloween of that year, the crash of Virgin Galactic’s SpaceShipTwo, which tragically and notably resulted in the first fatality from private spaceflight, one of the pilots aboard.[2] 2015 saw an international failure rate of 5.75%; five failures of the eighty-seven attempted launches.[3] Media darling SpaceX has experienced two rocket failures, the first in June of 2015[4] and the second at the beginning of September 2016.[5] Most recently, a Russian rocket also bound to resupply the ISS was lost in a late 2016 launch.[6]

These incidents are the growing pains of a technologically difficult activity being carried out by an increasingly diverse set of actors. The increases in the number of private actors

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[1] Mike Wall, “Private Orbital Sciences Rocket Explodes During Launch, NASA Cargo Lost” (28 October 2014): Space.com, <virghttp://www.space.com/27576-private-orbital-sciences-rocket-explosion.html>.

[2] Juliette Garside and Ian Sample, “Disaster at the speed of sound: the tragedy of SpaceShipTwo’s final flight” (7 November 2014) online: The Guardian <https://www.theguardian.com/science/2014/nov/07/virgin-galactic-tragedy-revealed-spaceshiptwo-disaster>.

[3] 2015 Space Launch Statistics (29 December 2015) online: spaceflight101.com, <http://spaceflight101.com/2015-space-launch-statistics/>.

[4] Mike Wall, “SpaceX Rocket Explodes During Cargo Launch to Space Station” (28 June 2015) online: Space.com, < http://www.space.com/29789-spacex-rocket-failure-cargo-launch.html>.

[5] James Dean, “SpaceX Falcon 9 rocket, satellite destroyed in explosion” (2 September 2016) online: Florida Today, <http://www.floridatoday.com/story/tech/science/space/spacex/2016/09/01/explosion-reported-spacex-pad/89710076/>.

[6] Stephen Clark, “Russian space station cargo freighter lost on launch” (1 December 2016) online: Spaceflightnow.com, <https://spaceflightnow.com/2016/12/01/progress-ms04-launch/>. https://spaceflightnow.com/2016/12/01/progress-ms04-launch/>.

in the space industry as well as the rapid development of space laws are indicators of growth in the commercial space sector. As early as 2008, the insured value of the in-orbit insured satellite fleet alone was $17.5 billion.[7] In 2010, of the almost 1,000 operational satellites in orbit, only 175 commercial satellites were insured.[8] As of 2015, the space insurance market covers approximately 205 satellites orbiting the Earth with a value of approximately $26 billion.[9] There has been an ongoing growth in entrepreneurial space activity, particularly in the United States; such companies as Virgin Galactic, SpaceX, Bigelow, Orbital Sciences, Xcor, Golden Spike, and Planetary Resources serve as examples. In 2009, the estimated total investment to the spaceflight industry was USD 1.46 billion. Of this investment, government contribution made up only 15%. Standard premium cost for launch insurance ranges from 15%-20% of the satellite's value; as far as this author is aware, the lowest rate ever negotiated for a launch insurance policy was 7%.[10] 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, 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.

[7] Chris Kundstadter, "What Keeps Space Insurers Up At Night…" (2008) XL Insurance.
[8] OECD, "Insurance market for space activities", (2011) The Space Economy at a Glance, OECD Publishing & OECD, "The Space Sector in 2011 and Beyond", (2011) The Space Economy at a Glance, OECD Publishing.
[9] Scott Ross, "Risk Management and Insurance Industry Perspective on Cosmic Hazards" in eds J.N. Pelton & F. Allahdadi, Handbook of Cosmic Hazards and Planetary Defense (Cham, Switzerland: Springer, 2015) at 1096.
[10] Joseph N. Pelton, "Satellite Deployment, Station-Keeping and Related Insurance Coverage" (2012) Springer Briefs in Space Development 75.

The United States Congress acted in 1988 to deal with the space insurance problem, by requiring cross-waivers of liability in space activities. Before 1988, the commercial space launch sector in the United States was faltering as a result of the unavailability of insurance, even at high premiums, for the immense liability faced by launch providers[11] 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 reasonably priced, comprehensive insurance would encourage further growth and development.

An Overview of this Thesis

There are many moving parts in a thorough understanding of space insurance, its legal parameters, and its governance role in the space industry. This thesis sets out to address as complete a picture as possible of those elements. Chapter 2 of this thesis will introduce the theoretical approach taken, namely, applying theories of non-State governance to the insurance industry to establish the extent to which it can or cannot serve a governing or regulatory function for the space industry. First, the chapter takes an analytical view of risk; explaining from a very basic perspective what risk is and why we take risk in space. Insurance is a traditional means of trading and sharing risk, and thus to understand insurance we must understand risk. This chapter then provides context for how insurers have acted as governors by contractually enforcing best practices on industry as a regulatory alternative in other sectors

[11] Martin Marietta Corp. v. INTELSAT (1991) 763 F.Supp. 1327.

and then applies this understanding to the space industry specifically. While comparisons have previously been made generally between space activities and high-risk sports/recreational activities, one section of this thesis provides a new approach to this issue. It specifically compares different types of mountain climbing to space activities from the perspective of societal value and perception, to help understand how we take and perceive risks in space. This chapter takes a socio-legal approach to addressing sub-research questions one and two. More specifically, identifying what risks we are taking in space and why can help to establish in a later review of the law what kind of regulatory formula could or should be applied in order to identify the gaps. The subsequent analysis allows the application the existing *insurance as governance* socio-legal theory to the space industry in particular, for which substantial study has not been previously undertaken.

Chapter 3 is the briefest chapter of this thesis, as it is the contextual chapter that provides background information on the space insurance industry so the reader may understand how the concepts to be critically analyzed apply to this sector. It is necessary background in order to effectively answer research subquestions two and three. This chapter reviews both the types of insurance currently available to the space industry and also the current capacity of the industry.

Standard third party space insurance policies, such as those offered by MunichRe (which claims to hold 15-20% of global space premium volume) include pre-launch insurance, launch insurance, and in-orbit insurance.[12] Those companies which articulate their coverage in greater detail include separate items for assembly, integration and test coverage; ser-

[12] "Market Requirements" Munich RE Space, available at < http://www.munichre.com/en/reinsurance/business/non-life/space/market.aspx>.

vice interruption, loss of revenue, broadcast events; and "captive cover" (an insurance company created by an entity or group to provide insurance for itself) to assist those companies which self-insure their space risks.[13] These types of insurance are more geared toward the satellite industry than to new, innovative space activities. Aon, a broker which claims to place over 35% of the world's space insurance premium, does not specify which coverage is offered, and instead offers tailor-made solutions.[14] Indeed, the larger space enterprises are apt to obtain "manuscripted" (individualized) insurance policies that are tailored to their specific needs. These policies are likely, however, to be extremely expensive and difficult to procure. Thus, the lack of standard coverage in the marketplace that can be endorsed to address the needs of particular entrepreneurial endeavors hinders development of such endeavors. The refinement and standardization of satellite-oriented insurance offerings would also contribute to increased insurance capacity at lower premium, allowing additional entrants to the satellite market. This is particularly important for those developing countries wishing to develop space capabilities.

Additionally, third party liability insurance the insurance that provides coverage to third parties not involved in the space activity or contract, is a particularly relevant developing area (see Allianz, Star Companies, and Torus for examples), especially given the current legal regime that provides for State liability. Some companies expressly do not cover such critical aspects of space activities as third party liability and pre-launch activities.[15] It is important to

[13] "Space Insurance" Allianz Global Corporate & Specialty, available at <http://www.agcs.allianz.com/assets/PDFs/risk%20insights/Factsheet%20spaceCo.pdf>.
[14] "International Space Brokers" Aon, available at: <http://www.aon.com/industry-expertise/space.jsp>.
[15] "Aviation and Space" SwissRe Corporate Solutions, available at: <http://www.swissre.com/corporate_solutions/industries/aviation_space/>.

note that first party liability, dealing with damages to one's own property, and second party liability, dealing with damages to those individuals with whom one contracts (such as passengers) are also important factors in the space insurance market and are in fact essential elements in a comprehensive *insurance as governance* approach.

This chapter also discusses Lloyd's of London in particular, which started as a maritime insurer, and provides an interesting and highly evolved model for insuring high risk ventures. The quota-sharing regime that allows risk-sharing among syndicates (and "names") enables the writing of insurance for very large risks, with less risk to the individual underwriting. It also allows those underwriters with particular expertise in an area to take the lead, demonstrating to insurers with less expertise that it is safe to take on a piece of that risk's pie. There is also substantial reinsurance that follows the initial underwriting process. Thus, they serve as a financially viable model with respect to the questions asked by this thesis.

Chapter 4 analyzes the legal and regulatory context that exists in outer space with regard to space activities and by extension space insurers, employing a doctrinal approach to identify and examine conflicts or gaps in the law relevant to the main research question. This context consists of laws and regulations that impact the insurance industry generally, and the space insurance industry in particular. This chapter provides substantial insight toward answering the first research sub-question and also contains an extensive literature review.

International space law currently consists primarily of the five major United Nations treaties (Outer Space Treaty, Return and Rescue Agreement, Liability Convention, Registration Convention and Moon Agreement), along with relevant declarations and guidelines on the one hand and national legislation on the other.[16] The instruments of international space law are critical to an understanding of the role of insurance in the space industry, and thus comprise Chapter 4 of this thesis. A brief overview is provided here, with additional overview followed by in-depth analysis of the relevant provisions contained in the chapter itself.

The Outer Space Treaty of 1967, the first and most comprehensive element of binding treaty law in space, assigns responsibility and liability through articles VI and VII for all space activities to the respective launching state carrying out those activities, even when the activities are carried out by private entities. Article VI, which assigns "international responsibility for national activities in outer space…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" creates a unique responsibility regime in international law. International responsibility for space activities rests solely on States.[17] Article VII renders States "internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons" by its space objects.

Article III of the Outer Space Treaty explicitly recognizes that principles of international law generally apply to space activities, bringing such documents as the Articles on Re-

[16] 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 205 [Outer Space Treaty]; Agreement on the Rescue of Astronauts and the Return of Objects Launched in Outer Space, 22 April 1968, 672 UNTS 119 [Return and Rescue Agreement]; Convention on International Liability for Damage Caused by Space Objects, 29 March 1972, 961 UNTS 187 [Liability Convention]; Convention on Registration of Objects Launched into Outer Space, 14 January 1975, 1023 UNTS 15 [Registration Convention]; Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 18 December 1979, 1363 UNTS 3 [Moon Agreement].

[17] Paul Stephen Dempsey, "Liability for Damage Caused by Space Objects Under International and National Law" (2012) XXXVII Ann Air & Sp L 333.

sponsibility of States for Internationally Wrongful Acts and International Court of Justice decisions into the relevant scope of space law for the purposes of understanding state responsibility. "[B]oth treaty law and general principles of international law on the subject of space law make the two elements of liability and responsibility a means to an end – that of awarding compensation to an aggrieved state or other subject under the law."[18] Thus, these general principles are likely to achieve the same aims even in cases where the Outer Space Treaty or Liability Convention (discussed below) do not apply).

The subsequent Liability Convention further expands the concept of state liability for space activities, assigning absolute liability for "damage caused by its space object on the surface of the Earth or to aircraft in flight" and fault-based liability for damage to a space object of another state or to persons or property on board such a space object.[19] The Outer Space Treaty and Liability Convention have 105 and 94 ratifications respectively, including most space-faring states, and as such have broad applicability.[20]

Additional requirements are imposed with regard to space activities by the other treaties mentioned above. The Registration Convention, for example, requires States to maintain national registries of space objects and to provide that information to the United Nations.[21] Under the terms of the Registration Convention, a launching state is required to register a space object.[22] Given that jurisdiction and control of a space object rests inseparably with the

[18] Ruwantissa Abeyratne, "Synergies and Problems in Outer Space Insurance and Air Transport Insurance" (2003) 30 Transp LJ 189.
[19] Liability Convention, *supra* note 16, art II-III.
[20] Status of International Agreements Relating to Activities in Outer Space as at 1 January 2017, COPUOS, UN Doc A/AC.105/C.2/2017/CRP.7 (2017) at 12.
[21] Registration Convention, *supra* note 16, art II & IV.
[22] Registration Convention, *supra* note 16, art II & V.

launching state in accordance with Article VIII of the Outer Space Treaty, the Registration Convention is also intertwined with the liability regime.

Article IX of the Outer Space Treaty requires that States act with “due regard” for the space activities of other States (and, therefore, other States’ private enterprises), avoiding “harmful interference” in carrying on space activities. It also specifies that adverse changes to the environment of Earth and harmful contamination of outer space are to be avoided. This article further contributes, albeit weakly, to the liability regime by creating a standard of care owed to other States and a basis for environmental requirements.

As a result of this international law regime, national regulations of many States require private entities to indemnify the state and to carry particular levels of third party liability insurance, including the United Kingdom, United States, France, Ukraine, Russian Federation, China, Japan and Australia. If private enterprises are to continue participating in space activities, there is an obvious need for the availability of insurance for space activities. Current insurance availability is not optimal for the encouragement of this industry, and must be further developed in light both of the legal regime and the unique risks inherent to outer space.

Finally, the principles of non-appropriation and free access play a role in terms of emerging industries that seek to mine or otherwise use and process non-renewable natural resources in space. Article II of the Outer Space Treaty mandates that outer space and celestial bodies are not subject to national appropriation, and there is an inherent regulatory risk present in the uncertainty that this principle creates with regard to mineral extraction. The lack of widespread ratification of the Moon Treaty, which does provide potential guidelines for the extraction and processing of such resources, leaves a legal lacuna in the regime.

While it is obvious why space law would play an essential role with regard to space insurance, it may not be as obvious that aviation law is potentially implicated as well. The critical issue of the delimitation between air space and outer space is analyzed in Chapter 5 and the the state of international liability and safety law with regard to aviation, including the ways that some space activities may be implicated, are explained in Chapter 6. Public international air law is governed primarily by the Chicago Convention on Civil Aviation and by the International Civil Aviation Organization (ICAO), created by that convention.[23] The international safety standards to which States and thus airlines adhere are derived from international cooperation through ICAO. Private international air law, mostly covering issues of liability, is handled through a combination of the Warsaw Convention and its Protocols, Montreal Convention, and Rome Convention.[24] While none of these treaties can be said to govern space activities, the status of suborbital activities such as parabolic flight and high altitude ballooning is as of yet unsettled, and thus these treaties provide a safety and liability regime that could be utilized, particularly for suborbital point-to-point ventures, to increase certainty in the space field as they have done for aviation.

Of course, these instruments of air law will only gain relevance for such "space" activities if they are deemed to be, in fact, aviation activities. The lack of surety surrounding the liability regime for suborbital ventures is one reason why the lack of a line of demarcation

[23] Convention on International Civil Aviation, 7 December 1944, 15 UNTS 295, ICAO Doc 7300/6 [Chicago Convention].
[24] Convention for the Unification of Certain Rules Relating to International Carriage by Air 137 LNTS 11 (1929) [Warsaw Convention]; Montreal Convention for the Unification of Certain Rules for International Carriage by Air, ICAO, 2242 UNTS 309 (1999); Montreal Protocol No 4 to Amend the Convention for the Unification of Certain Rules Relating to International Carriage by Air, Signed at Warsaw on 12 October 1929 as Amended by the Protocol Done at the Hague on 28 September 1955, 25 September 1975, ICAO Doc 9148.

between air space and outer space is so critical. States (including the U.S.) have formed national policies where necessary regarding the status of certain ventures, creating an unharmonized patchwork of rules and standards. The importance of determining a clear regime applicable to each activity for the purposes of efficient, confident insurance writing cannot be understated.

Chapter 7 of this thesis delves into the particular space legal and regulatory regime in effect in the United States. Given the advanced nature of national space law in the U.S., and the plethora of private space entities based there, the U.S. is the primary geographical focus of this thesis and this American author's research. The impact of U.S. national space law on the procurement of space insurance is likewise addressed. This doctrinal chapter contributes primarily to research sub-question one, in identifying and analyzing gaps in the space law regime from a U.S. perspective. The Executive Office of the President has in fact specifically identified gaps in existing space law with regard to private missions beyond Earth's orbit, on-orbit servicing activities, and space resource utilization.[25]

By way of brief overview, in 2010, the body of existing statutory national space law in the U.S. was codified into Title 51 of the U.S. Code.[26] Title 51; along with the FAA Regulations promulgated under the authority of Title 51,[27] and as codified in the Federal Code of Regulations (FCR); and the FCC Regulations that govern the use of radio frequencies[28] (es-

[25] John P. Holdren, Executive Office of the President/Office of Science and Technology Policy (4 April 2016) online: WhiteHouse.gov, <https://www.whitehouse.gov/sites/default/files/microsites/ostp/csla_report_4-4-16_final.pdf>.
[26] National and Commercial Space Programs, 51 USC (2010).
[27] 51 USC §§ 50901 et seq.
[28] U.S., Communications Satellite Act art. 201(c)(11); Communications Act titles I-III (1934); Telecommunication, 47 CFR §§ 25.157-25.158.

sential for space operations), promulgated under the authority of the Communications Act and the Communications Satellite Act,[29] provide the procedures by which a private U.S. entity wishing to engage in space activities must obtain proper licensing. The Commercial Space Launch Competitiveness Act was signed into law in the U.S. in November of 2015; analysis of that act will be included both in this section and in the relevant section in Chapter 8 regarding space resource utilization along with analysis of emerging technology areas where gaps exist.

Chapter 7 also addresses three other key areas of national space law in the U.S., State Spaceflight Liability and Immunity Acts, and export controls. Six U.S. States (Virginia,[30] Florida, California, Texas, New Mexico, and Oklahoma) have promulgated such Spaceflight Liability and Immunity Acts,[31] which have been preempted from 25 November 2015 through 2025 by the Commercial Space Launch Competitiveness Act, mentioned above. The purpose of these acts is to eliminate liability for participant injuries resulting from the risks of spaceflight activities when all the relevant procedures contained in the acts are followed. The importance of these acts is twofold: first, if effective, they would have a significant beneficial effect on reducing insurance costs of ventures which include human spaceflight participants; and second, they set a precedent for managing spaceflight participant liability at the earliest stages of industry development, as these States are the sites of key spaceports. These waivers

[29] *Ibid.*
[30] Spaceflight Liability and Immunity Act, Va H.B. 3184, §8.01-227.8 & §8.01-227.9 (2007) [VA Spaceflight Act].
[31] Spaceflight Informed Consent Bill, Fla S.B. 2438 (2008) [FL Informed Consent]; Spaceflight Liability and Immunity Act, 5 Ca Civil C tit 7 § 2210 (2012) [CA Spaceflight Act]; Limited Liability for Space Flight Activities Act, Tex Civ Prac C tit 4 Ch 100A (2011) [TX Spaceflight Act]; Spaceflight Informed Consent Act, N Mex S.B. 240 (2013) [NM Informed Consent]; Spaceflight Liability and Immunity Act, Okla Stat tit 3 § 351 (2013) [OK Spaceflight Act].

effectively move liability away from the service providers, and thus incentivize purchase or provision of private insurance in case of loss. Unfortunately, such waivers are not always internationally recognized, and this chapter will explore the issues with implementation of these waivers with regard to international transit.

Export controls, the third essential area of national regulation discussed in Chapter 7, have been a significant burden to the space insurance industry. In the United States, designation on the Commerce Control List (CCL[32]) or International Traffic in Arms Regulations (ITARs)[33] list impacts the procedures that must be followed to "export" these technologies, which have historically included satellite and launch technologies. Export, in this case, includes the disclosure of technical data: by oral, visual, or written means, and thus includes information that would need to be provided to insurers for effective underwriting.[34] As many prominent space insurers are located outside the U.S., (e.g., Lloyd's and MunichRe) difficulty exists in providing sufficient technical data to mollify insurers as to the viability of U.S. space ventures due to export restrictions.

A number of new, innovative applications for space activities have emerged, or soon will. These include space based solar power (SPS), mining and resource extraction, human spaceflight, suborbital spaceflight, orbital and beyond orbit spaceflight, and the deployment of small cubesats. Special considerations for these new activities are addressed in Chapter 8, which provides both doctrinal and normative approaches to developing an appropriate framework for these technologies. One of the primary concerns with regard to such innova-

[32] National Defense Authorization Act for Fiscal Year 2013, US Pub L 112-239.
[33] US Department of Commerce & Federal Aviation Administration, Introduction to US Export Controls for the Commercial Space Industry (2008), online: Commerce Department, <http://www.space.commerce.gov/library/reports/2008-10-intro2exportcontrols.pdf>.
[34] Foreign Relations, 22 CFR § 120.17.

tive activities is the unavailability of standardized insurance. Individualized ("manuscripted") policies tend to be expensive both due to the amount of work that goes into producing them and, more importantly, due to the uncertainty of the risks involved. An understanding of the ways in which law and regulations impact these activities will help insurers produce more efficiently priced insurance, and thus may also help new entrants to the space insurance market take on some of these risks. Of course, the actuarial concerns with regard to policy pricing are largely beyond the scope of this thesis. Included in this chapter are recommendations for handling the specialized issues relevant to these industries.

Given that one of the purposes of this thesis is to produce sound recommendations for insurance as governance in the space industry, a discussion of the key parts of an insurance policy is critical to understanding the relevant issues, and is provided in Chapter 9 of this thesis. This chapter takes a doctrinal approach, heavily relying on common law cases, primarily from U.K., home of Lloyd's, which is discussed in more detail in Chapter 3. Part A introduces principles of contract interpretation that apply to insurance policies and compares them to similar treaty interpretation provisions, offering another comparison of how insurance and governance may share forms and similarities. This analysis is both doctrinal and comparative in nature. Part B provides a doctrinal review the key features of an insurance policy that legal counsel should expect to find and manage in the context of a space insurance policy, as these are quite different than what might be found in a treaty or international agreement. This chapter contributes to answering research sub-questions two and three, identifying if the terms of insurance policies can be used to govern the space industry and what areas may provide particular opportunities for such use or for improvement generally.

Chapter 10 provides an in-depth study of the space debris problem and how insurance can help to solve that problem as a regulatory force. A unique comparative approach is taken, comparing the history and development of steam boiler insurance standards as a regulatory mechanism, as facilitated by the Hartford Steam Boiler Insurance Company (HSB) to approaches that could be taken in the space industry. This chapter contributes substantially to answering sub-question two generally, and providing specific concrete examples for answering sub-question three. Doctrinal analysis of space law specifically relevant to the problems discussed in this chapter, namely space debris, facilitates this process.

Additionally, there are areas of insurance coverage that are not included in a "standard" space insurance package that could be leveraged to improve the commercial viability of space activities and prevent disaster in the future. Chapter 10 addresses these types of coverage to provide additional answers to research sub-question three. Specifically, regulatory insurance, intellectual property insurance, and technology risk appear to be prime areas that would benefit space industries. Regulatory insurance is a type of insurance, commonly offered in the medical field, which covers fines and penalties levied by regulators. This type of insurance could prove valuable to the space industry, with evolving national regulations and the potential that an individual company could be subjected to the regulations of multiple States. Intellectual property insurance protects against allegations of infringement and depending on the coverage provided can also protect the intellectual property rights of the company against potential infringers. This type of insurance typically covers copyright, trademark, or patent infringement claims. Given the levels of innovation in the space industry and regulations regarding technology transfer, this type of insurance could be very beneficial in the space industry, particularly if bundled with regulatory insurance. Cyber insurance covers a range of both first and third party losses, including loss or destruction of data, network damage, system failure, breach of confidentiality, invasion of privacy, and transmission of computer viruses, for example. Privacy breach response insurance is a particularly interesting and rapidly expanding field of insurance that has developed in response to regulations that have been promulgated requiring notification and monitoring when data breaches occur. With the vast quantity of data carried by satellites and the increasing likelihood of attacks on such satellites, it is easy to see the potential relevance of a modified form of this insurance in the space arena.

Chapter 11 provides the arrived upon answers to the research questions posed, including recommendations for the future. The challenges and opportunities presented by insurer governance are presented, and the conclusion that insurers are well positioned to provide governance as a stop-gap measure ahead of the readiness of government actors to do so is reviewed. "Global risks have the power to confuse the mechanisms of organized irresponsibility and even to open them up for social and political action."[35] In other words, insurance doesn't exist in a vacuum[36] (but insurance certainly exists in space).

In summation: this thesis is a socio-legal approach to the unique problems of insurance embedded in a high risk (high technology/low predictability) space environment governed by a treaty regime of state responsibility and liability for private actors.

[35] Ulrich Beck, World at Risk (Malden, MA: Polity Press, 2014) [Beck 2014] at 59.
[36] Jonathan Simon "Taking Risks: Extreme Sports and the Embrace of Risk in Advanced Liberal Societies" in Tom Baker & Jonathan Simon eds, Embracing Risk: The Changing Culture of Insurance and Responsibility (Chicago: University of Chicago Press, 2010) at 171.

Chapter 2: Insurance as Governance in Space

Introduction

The premise of this chapter is the idea that insurance can act as governance, specifically, by providing a regulatory function that may be absent in certain cases at the State level through decisions on who to insure, policy conditions and terms, as well as premium-setting. This function can be fulfilled through contractual requirements and/or incentives. Best practices can be implemented first as ways to obtain premium discounts and subsequently as requirements, spreading across the industry as insurers struggle to remain competitive with their peers and cooperative with their clients.

This idea is not a new concept that has emerged with space activities, but rather the theoretical interrelationship between insurance and governance has been explored in a socio-legal context, particularly over the course of the last two decades. The primary original contribution of this thesis is the comprehensive study of the extension of this proposition to the space industry. Application of this theoretical approach leads to the conclusion that the international nature of major space insurers and near-universal need for their products uniquely positions this group to act as a form of quasi-governance that can contractually enforce (or at least incentivize) best practices that effectively function as regulation for the industry in partial answer the question "Are insurance companies in a position to be able to fill or partially fill that [regulatory] void?"

The history of state-provided insurance and the growth of a powerful insurance industry will show how an *insurance as governance* approach has developed outside the space industry and indeed how insurers execute a governance function to varying degrees in different sectors regardless of whether they do so with intent or merely as a byproduct of their risk-management activities. While there has been substantial discussion regarding whether or not the space industry should be heavily regulated, this approach affords an opportunity to provide a more incremental and business-sensitive means to ensure safety and sustainability.

What is Risk?

Before addressing an in-depth discussion of the insurance industry and its role in governance, it is necessary to understand risk – the element we are insuring against. In order to secure the institutional environment, including both normative and regulatory structural aspects,[37] society invests substantial institutional resources in the understanding of risks.[38] Before we can address the institutional management of risk, we must understand its basic underpinnings. What is risk? A risk is fundamentally an external danger, though by some definitions (including the one advanced by notable scholar Ulrich Beck), simple dangers are phenomenon to which we are passively exposed to, while we actively take risks upon ourselves.[39] Internal dangers are excluded from this particular discussion because they are dangers directly caused by one's self rather than dangers of an activity in which one chooses to participate. Included in the meaning of risk are the systems for communicating risk. These

[37] James B. Wade & Anand Swaminathan, "Institutional Environment" (19 December 2014) online: Palgrave, <http://www.palgraveconnect.com/esm/doifinder/10.1057/9781137294678.0316>.
[38] Richard V. Ericson, Aaron Doyle, & Dean Barry, Insurance as Governance (Toronto: University of Toronto Press, 2003) [Ericson et al] at 33; Ulrich Beck, Risk Society: Towards a New Modernity (Los Angeles: Sage, 1992); Mary Douglas and Aaron Wildavsky, Risk and Culture (Los Angeles: University of California Press, 1983); Richard V. Ericson and Kevin D. Haggerty, The Policing of Risk (Toronto: University of Toronto Press, 2007).
[39] Beck 2014, *supra* note 35 at 84.

systems not only set parameters for organizational accomplishment but also govern institutional relations.[40] This, however, is a cyclical explanation. Institutions invest substantial resources in understanding risk, but risk systems also govern institutional relations. So, we must first look at risk from a more basic perspective to understand these complex relationships.

There are many varied definitions of risk, but one very simple explanation can be perceived through the wildly popular mass market war game (i.e., "Risk") with the goal of in-game global domination.[41] While it may seem unusual to discuss risk in an insurance and international law context through the lens of a recreational board game, this perspective enables the presentation of a few key topics. The reality is that the game is aptly named. Risk derives from making choices. Action and inaction are both choices. In the game, players' choices include how many troops to station in each territory, how to obtain the greatest number of new troops per round, who to attack, and with which players to form alliances. The player is unable to control the actions of the other players or the outcome of the dice rolls on each attack – two very different types of risk that are also inherent in multitudinous aspects of life. Thus, there is both social and probabilistic risk inherent in the game. "Understanding the principles of probability that are implicit in the game is a key building block of success."[42] Those players who are averse to the luck of the dice roll will instead opt to play Diplomacy, which by its rules limits itself to social risk without probabilistic risk. The strategies inherent to those two board games could form an entire (non-legal) thesis in and of themselves, which

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[40] Ericson et al, *supra* note 38 at 33.
[41] "Risk" online: Board Game Geek, <https://boardgamegeek.com/boardgame/181/risk>.
[42] Garrett Robinson, "The Strategy of Risk" online: MIT, <http://web.mit.edu/sp.268/www/risk.pdf>.

is beyond the scope of this discussion, as the innate risks in outer space activities include both social and probabilistic risk.

When conflicts occur between small numbers of troops, understanding the probability factors is a relatively simple task. However, when the scale of conflict increases, the outcome is much more difficult to predict.[43] With this probabilistic risk, the future can be predicted by measurement, even if these predictions are speculative. Thus, quantitative calculations act as a basis for decisions regarding danger.[44] If a player is too riskphobic, she leaves too much opportunity for other players to quickly acquire valuable territory and increase their armies to unmanageable levels, but if she embraces too much risk, she will spread her army too thin and be knocked out of the game quickly. The very same can be said of entrepreneurial activities in outer space: if companies wait too long to perfect their technologies and ensure safety, they will be outpaced by the competition. If they take too many risks, they are likely to suffer failures and accidents that will bankrupt both the coffers and the good will of the company, leading to failure. One well publicized example of this in the aviation sector was ValuJet, the discount airline that suffered substantial losses and eventually underwent a merger as a result of its well-documented risky safety practices and the 1996 crash that resulted therefrom.[45]

Players of the game must balance risk and security. Likewise, States who under-regulate their space industry may gain participation and revenue from a greater number of countries, but will open themselves to possible claims for any damages that are caused, in

[43] *Ibid*.
[44] Beck 2014, *supra* note 35 at 84.
[45] Martha Brannigan & Asra Q. Nomani, "ValuJet Safety Checks Deal Carrier a Financial Blow" *The Wall Street Journal* (20 May 1996) online: WSJ, <http://www.wsj.com/articles/SB832547958526132500>; "Revamped ValuJet begins service under a new name" *CNN* online: CNN.com, <http://www.cnn.com/TRAVEL/NEWS/9709/24/valujet.presser/>.

accordance with their obligations under international law. A State that over-regulates, however, will drive away entrepreneurs and thus fail to reap the benefits of a domestic space industry. One example of this phenomenon is the relative weakening of the US satellite market vis-à-vis the European market in correlation with the more stringent American export controls, as discussed in more detail in Chapter 7. In these analogies, the social risk consists of the actions of other companies and States, while the probabilistic risk consists of the chances for technological failure and damage as well as atmospheric and space-based phenomena. All actions and inactions have consequences, and as such, insurance produces other risks in the process of managing risk.[46]

Risk itself is not catastrophe; but rather it is anticipation of catastrophe.[47] When the catastrophe occurs and risk becomes real, risk moves on to new possibilities.[48] Risks are the product of institutional and organizational dynamics that can shape knowledge and behavior.[49] Quantifying risk is a survival mechanism innate to the human race. From the days cavemen built shelters to protect themselves from the elements, the goal has been to mitigate risk."[50] Experts have argued that there has been a transformation in the societal approach to risk and responsibility towards embracing risk from the beginning of the 21st century.[51] Literature of risk assessment and management is concerned with "identifying, measuring, reducing and otherwise managing risk."[52] Risk today encompasses both the concept of bad risks,

[46] Ericson et al, *supra* note 38 at 9.
[47] Beck 2014, *supra* note 35 at 81.
[48] *Ibid.*
[49] Simon, *supra* note 36 at 171.
[50] Ross, *supra* note 9 at 1086.
[51] Tom Baker, & Jonathan Simon eds, Embracing Risk: The Changing Culture of Insurance and Responsibility (Chicago: University of Chicago Press, 2010) at 1.
[52] *Ibid* at 18.

but also opportunities that can be gained only through risk-taking. The anticipation of catastrophes can act as a force, both socially and politically, to motivate development and change.[53] Thus, this concept of embracing risk grows out of a belief that risk can be a positive contributing force to social development.[54] In summation: "Risk: The Loftier Your Goals, The Higher Your Risk, the Greater Your Glory[,]"[55] but also the greater your chances of failure, shame, and/or bankruptcy.

Space activities are ultra-hazardous activities with substantial danger.[56] As stated above, the term risk encompasses not only external dangers, but also the risk communications systems used to recognize and respond to those dangers. Risk is not simply a danger or hazard.[57] Risk communication systems, in fact, produce new risks because they modify behaviors. A risk communication system can be defined as a "process of exchanging information among interested parties about the nature, magnitude, significance, or control of a risk."[58] For example, though it was widely communicated that seat belts do increase the likelihood of survival in the event of a car accident, the wearing of seat belts could possibly increase the

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[53] Beck 2014, *supra* note 35 at 81.
[54] Baker & Simon, *supra* note 51 at 20
[55] Simon, *supra* note 36 at 177.
[56] UN Int'l Law Comm'n, Draft articles on Prevention of Transboundary Harm from Hazardous Activities, with Commentaries 149-151, UN Doc.A/56/10 (2001); V.S. Mani, The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Space Objects Launched into Space 1968, U.N. Office of Outer Space Affairs (2003), online: <http://www.oosa.unvienna.org/pdf/sap/2003/repkorea/presentations/manidoc.pdf>. Take, for comparison, 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 at least as good as one in two million. Denis Bensoussan "Space tourism risks: A space insurance perspective" (2010) 66 Acta Astronautica 1633 at 1637.
[57] Anthony Giddens, "Risk and Responsibility" (1999) 62:1 Modern L Rev 1 at 3.
[58] VT Covello, "Risk Communication: An emerging area of health communication research" in SA Deetz, ed, *Communication Yearbook 15* (Los Angeles: Sage, 1992) at 359.

risk that car accidents will occur because the increased feeling of safety might promote risky driving behavior.[59]

Risk society is made up of institutions that use risk as a basis on which to organize themselves, expending significant resources on risk management.[60] It exists on a technological frontier that transforms human society to generate a plethora of possible futures.[61] In simpler terms, one can make decisions such as purchasing selections based on various technological means of managing risk, creating a wide range of possible outcomes in terms of risks mitigated and created.

Risk is not only a danger and a series of danger communication systems, but also a social relationship; between those who have technology and those who lack it.[62] This is particularly apparent in the realm of space situational awareness, where most States do not have the capability to produce that risk awareness data. Both human decisions and human made futures including probability, technology, and modernization influence risk. The combination of modern technology and risk-as-anticipation creates a continuity where the future is perceived as an extended present that we influence now.[63] The idea of risk includes aspirations to control the future.[64] As technology increases and changes possible outcomes, institutions

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[59] John Adams, "The Failure of Seat Belt Legislation" in Marco Verweij and Michael Thompson, eds *Clumsy Solutions for a Complex World: Governance, Politics and Plural Perceptions* (London: Palgrave Macmillan, 2006).
[60] Ericson & Haggerty, *supra* note 38 at 238.
[61] Giddens, *supra* note 57 at 3.
[62] Francois Ewald (translated by Stephen Utz), "The Return of Descartes's Malicious Demon: An Outline of a Philosophy of Precaution" in Tom Baker & Jonathan Simon eds, Embracing Risk: The Changing Culture of Insurance and Responsibility (Chicago: University of Chicago Press, 2010) at 296.
[63] Beck 2014, *supra* note 35 at 81.
[64] Giddens, *supra* note 57 at 3.

must adapt to to these changes and establish systems of responsibility that can handle these new challenges.

Over the course of the twentieth century, law and responsibility were shaped into a system based on compensation utilizing risk and insurance.[65] This has developed alongside a political environment where responsibility and accountability are emphasized.[66] Precaution and prevention grow from responsibility and accountability. As a space-faring society, it is our responsibility to prevent catastrophe (e.g., Kessler syndrome, which is described in more detail in chapter 10 that addresses the issue of space debris) and to ensure that parties who cause damage are accountable and responsible for their actions. These principles are fundamental not only to our risk society, but also to the international space law regime.

Despite the integral role that risk-taking plays in liability and the close linkage between risk and responsibility, risk does not factor prominently in legal writing.[67]

To Boldly Go: Risk-taking in space activities

The twentieth century can be characterized as the insurance age where there was a great deal of faith in security by rational risk control.[68] The twenty-first century, however, is more of an age of willingness to take risk as a means to success.[69] There is potential that risk can

[65] Ewald, *supra* note 62 at 281.
[66] Beck 2014, *supra* note 35 at 81.
[67] Giddens, *supra* note 57 at 1.
[68] Martha McCluskey, "Rhetoric of Risk and the Redistribution of Social Insurance" in Tom Baker & Jonathan Simon eds, Embracing Risk: The Changing Culture of Insurance and Responsibility (Chicago: University of Chicago Press, 2010) at 146.
[69] *Ibid*.

have a substantial transformative power in society.[70] This presents a possibly artificial view of the tension between security and risk. Policies that embrace risk can also redistribute risk. In discussing risk versus security, it is necessary to evaluate not only how much risk is being taken, but who is taking the risk.[71]

Space activities are manufactured risks, characterized by de-localization, incalculableness, and scientifically induced not-knowing.[72] In other words, the risks are spread across a wide field of geographic parameters, have not been repeated sufficiently to produce calculable risk tables, and are so far on the cutting edge of science that new, unpredictable models have been introduced. For a somewhat simpler and more easily testable example, consider new pharmaceuticals that wind up producing myriad unexpected effects, often even after extensive testing and approvals. Manufactured risks, especially the kinds of technology employed in space, are a type of risk with which we have very little previous experience and which is actually created by the progress of human development, science, and technology.[73] When you consider the length of human history and the period in which we have been dealing with these kinds of manufactured risks, you will find that we are looking at a very tiny percentage of our overall experience.

Risk and security present a vision of societal interdependence with regard to allocation of costs and benefits.[74] There is a particular interdependence spurred by the global impact space activities do have and can have on Earth – in terms of data and technology, in terms of the possibility for space objects to impact almost anywhere, and in terms of the potential for

[70] Beck 2014, *supra* note 35 at 83.
[71] McCluskey, *supra* note 68 at 146.
[72] Beck 2014, *supra* note 35 at 82.
[73] Giddens, *supra* note 57 at 4.
[74] McCluskey, *supra* note 68 at 147.

the creation of a space debris cloud, for some examples. These risks are not limited in geographic scope.

Types of risks to those participating in space activities can include possibilities for, e.g., damage or injury due to faulty manufacturing of launch vehicle components, improper launch mission performance, mishaps occurring at a launch site connected with launching services, delay in performance of a launch mission, and unauthorized disclosure of proprietary data (particularly in the case of remote sensing).[75]

In summation, risks inherently must be described with reference to value.[76] Driving is known to be a risky behavior, but yet it provides us sufficient value that most people are willing to get into their vehicles on a daily basis and take that risk in exchange for the benefits provided by relatively speedy local mobility. What do we, as a society, value that encourages our ventures into space?

Comparison to Mountain Climbing

Activities that bear a promise of increased wealth or psychological thrills have become increasingly legal and acceptable – this includes gambling, participation in the stock market, extreme sports, adventure travel, and even space tourism. This cultural shift has come both in terms of direct participation and also indirect participation in terms of reading about or

[75] Peter D. Nesgos, "The Challenges Facing the Private Practitioner: Liability and Insurance Issues in Commercial Space Transportation" (1989) 4 JL & Tech 21 at 22.
[76] Giddens, *supra* note 57 at 5.

watching those individuals who do participate.[77] Extreme sports and adventure travel have rapidly become major parts of the recreation market in postindustrial societies, signaling a society shift to the embrace of risk.[78] Even when it comes to people watching or reading about risky sport and adventure activity, a message is produced that idealizes the attributes of those individuals willing to take personal risk.[79] Much like space tourism, corporate executives and wealthy financiers make up a substantial portion of the customer base at the high end of the adventure travel industry.[80] Space business follows the same model in two separate examples: where wealthy entrepreneurs have become willing to risk portions of their fortune for some combination of additional financial success and glory in undertaking space activities and where wealthy individuals (the only ones who can afford to do so, at this stage), pay for space tourism experiences themselves.

In this vein, mountain climbing is a well-known and symbolic extreme sport that has been recognized since the eighteenth century and which has recently begun to gain both participants and followers. UC Berkeley law professor Jonathan Simon presents an interesting and clear view of mountain climbing that serves as a valuable basis for comparison to the space industry. As such, this section reviews and analyzes his assessment of climbing and provides a basis for this author's assessment of the space industry as a high-risk sport.

Climbing can be seen as a symbol of personal triumph over adversity,[81] much as escaping the atmosphere is a symbol of overcoming human limitations. Climbing can be divided

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[77] Baker & Simon, *supra* note 51 at 6.
[78] Simon, *supra* note 36 at 179.
[79] Nickolas Rose, Powers of Freedom (Cambridge: Cambridge University Press, 1999); Simon, *supra* note 36 at 180.
[80] Simon, *supra* note 36 at 181.
[81] *Ibid.*

into two aspects: summiteering (emphasis on the act of reaching the summit, highlights competition and struggle) and mountaineering (more complete view of life on the mountain, highlights cooperative effort and environment).[82] In the case of summiteering, *fetishization of the summit* provides a self-esteem gain through an individual achievement.[83] Alternatively, mountaineers rather than summiteers view their personal gain as an intrinsic knowledge of the feeling of aliveness achieved during their mountaineering experience.[84] "Summiteering tends to treat the risk of the climb as a wholly natural obstacle, the overcoming of which grants to the human climber a victory over an external reality with a fixed and constant meaning. Mountaineering, in contrast, produces a self-consciousness about the constructed nature of the risks involved in climbing."[85] These two versions of climbing can be transposed to the space industry. Trained astronauts (be they traditional government astronauts or the trained private pilots and future crews that are being assembled) are more similar to mountaineers, whereas many if not most space tourists are more like summiteers. This divide can also be seen in the discussions regarding whether or not the terms "astronaut" and "personnel of a spacecraft" were meant to encompass our space tourist summiteers.[86]

Interestingly, the tragic death of nearly a dozen climbers on Mount Everest in May 1996 encouraged attention and participation in the sport rather than generating a backlash against it.[87] In spite of this unfortunate incident, there has not been any sustained call for pro-

[82] *Ibid* at 181 & 182.
[83] *Ibid* at 190.
[84] *Ibid* at 193.
[85] *Ibid* at 193.
[86] See further discussion of this point later in this section.
[87] Simon, *supra* note 36 at 180.

hibition or additional regulation of similar risk-taking activity.[88] There is in the space tourism industry a similar sense of intense competition that Professor Simon perceives among commercial Everest expedition outfitters that could result in dangerous conditions.[89] Unfortunately, however, there has not been such an acceptance of risk in the space sector as in the mountaineering community. An unwillingness on the part of society to accept human casualties in the space arena has emerged. Given the type of risk inherent in space activities, the demarcation between rationality and hysteria can become blurred, [90] much as the boundary between air space and outer space is notably undefined.

Analogously to the space industry, the participation of less-committed climbing enthusiasts creates a risk of diluting or destroying the core values and special features of climbing. This can cause confusion about expectations of behavior and individual activity during a climb. Traditionally, each member of a climbing party is an equal and takes responsibility for the care and well-being of the others participating in the expedition. When climbing becomes associated with expensive consumer services, it creates a different expectation in carrying out the roles of customers.[91] A parallel can be drawn here between traditional astronauts, who have years of training and participate closely as a team with their crew members, and spaceflight participants, who may undergo minimal training and lead-time with their fellow travelers. As a right of passage, "[t]he mountain is metamorphosed into a test that marks the partic-

[88] *Ibid* at 184.
[89] *Ibid* at 183.
[90] Beck 2014, *supra* note 35 at 83.
[91] Simon, *supra* note 36 at 186.

ipant as among an elect"[92] as entering space creates its own elite category of individuals. At this writing, only 558 people have been to space.[93]

Another parallel of the risk between space activities and mountaineering is the problem of rescue. Generally speaking, someone in need of rescue in either case will be dependent on those who have the capability to undertake a rescue. In mountaineering tradition, the rescue should be undertaken if it is possible to do so. The flood of underprepared and/or unskilled climbers who find themselves in need of rescue has caused some uproar in the community and among regulators, who have become more apt to charge user fees or set limitations on who is permitted to climb.[94]

Likewise, in space, there is substantial debate surrounding the question of whether a passenger or spaceflight participant can be considered an astronaut for the purposes of rescue obligations under international law. Under the Outer Space Treaty, astronauts of State Parties engaged in activities in outer space are required to provide "all possible assistance" to astronauts of other State Parties.[95] "This duty for astronauts to assist each other has the advantage of being utterly unqualified – and therefore requires such assistance under any circumstances and in any location."[96] Article IX of the OST also creates a duty of mutual assistance.[97] Be-

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[92] *Ibid* at 192.
[93] "Astronaut/Cosmonaut Statistics (as of 12/4/2016)" online: WorldSpaceFlight.com <http://www.worldspaceflight.com/bios/stats.php>.
[94] Simon, *supra* note 36 at 195.
[95] Outer Space Treaty, *supra* note 16, art V(2); Mark J. Sundahl, "The Duty to Rescue Tourists and Return Private Spacecraft" (2009) 35 J Space L 163 at 168.
[96] *Ibid.*
[97] Michael Mineiro, "Article IX's Principle of Due Regard and International Consultations: An Assessment in Light of the European Draft Space Code-of-Conduct" in Proceedings of the 5th E. Galloway Symposium on Critical Issues in Space Law, Washington, D.C., International Institute of Space Law (2 December 2010) 674 [Mineiro "Article IX"] at 676.

cause the term “astronauts” is used, it has been argued that there is no duty to rescue non-crew members or passengers.[98] Neither the Outer Space Treaty nor the Rescue Agreement define the terms “astronaut” or “personnel of a spacecraft” and these terms are not necessarily equivalent.[99] The latter term can be construed more broadly and would include space engineers, scientists,[100] pilots, crew members, technicians and physicians accompanying the flight,[101] but would not necessarily include passengers.[102] The divide between these two types of actors can be seen on the mountaineering side as well, one author and mountaineer writes: “During my thirty-four-year tenure as a climber, I’d found that the most rewarding aspects of mountaineering derive from the sport’s emphasis on self-reliance, on making critical decisions and dealing with the consequences, on personal responsibility. When you sign on as a client, I discovered, you are forced to give up all of that and more.”[103]

While spaceflight participants may be minimally trained, fairly passive participants in the spaceflight adventure, on the one hand, it would be inhumane not to consider a rescue obligation to apply to these individuals, but on the other, it may be unduly burdensome as space tourism grows to expect the same level of risk and expense to be undertaken. Article V of the

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[98] Stephen Gorove, “Legal Problems of the Rescue and Return of Astronauts” (1969) 3 Int’l L 898 at 900.

[99] Zhao Yun, “A Legal Regime for Space Tourism: Creating Legal Certainty in Outer Space” (2009) 74 J Air L & Comm 978.

[100] Fred Kosmo, “The Commercialism of Space: A Regulatory Scheme that Promotes Commercial Ventures and International Responsibility” (1988) 61 S Cal L Rev 1055 at 1071.

[101] Roy S.K. Lee, “Assistance to and Return of Astronauts and Space Objects” in Manual on Space Law, Nandasiri Jasentuliyana & Roy S.K. Lee eds (New York: Oceania, 1979) 54.

[102] Steven Freeland, “Up, Up and…Back: The Emergence of Space Tourism and Its Impact on the International Law of Outer Space” (2005) 6 Chi J Int’l L 1 at 3.

[103] John Krakauer, Into Thin Air (New York: Anchor Editions, 1998) at 219; Simon, *supra* note 36 at 187.

OST and the preamble to the Rescue Agreement[104] establish that space-faring nations have an interest in the humanitarian duty to render assistance to astronauts in distress, which implicates elementary considerations of humanity in international law.[105] A humanitarian duty to provide assistance originates in sea and air law, respectively.[106] "This practice arose out of humanitarian and enlightened self-interest, eventually achieving domestic and thereafter international legal status."[107] This duty was previously codified in treaties concerning rescue in both the maritime and aeronautical environments,[108] and subsequently in the Outer Space Treaty.[109] Fundamentally, however, this author argues that the principle of interpretation precluding an absurd result under the Vienna Convention on the Law of Treaties would govern here;[110] it would be absurd to require the rescue of pilots and crew of a space object, without requiring rescue of the other humans aboard.

In recent years we have seen resistance to loss and demands for zero risk by society and the general public,[111] this encompasses a number of industries, including both aviation and space. “Today, we tend to measure the risk on the basis of this residual portion: what is worth sacrificing for this? Are those who are unlucky enough to be among the victims of so much less value than the others? This is the method of valuation that lies behind the zero risk prob-

[104] Return and Rescue Agreement, *supra* note 16.
[105] Corfu Channel (UK v Alb), 1949 ICJ Reports at 4 at 22 (April 9).
[106] Mani, *supra* note 56.
[107] Mineiro “Article IX”, *supra* note 97 at 676.
[108] Paul G. Dembling & Daniel Arons, The Treaty on Rescue and Return of Astronauts and Space Objects, (1968) 9 Wm & Mary L Rev 630 at 650.
[109] Mineiro “Article IX”, *supra* note 97 at 676.
[110] Vienna Convention on the Law of Treaties, 23 May 1969, 1155 UNTS 331 [VCLT], art 32(a). For discussion of why the VCLT principles of interpretation can be applied to space law, see Chapter 4: International Space Law in Context.
[111] Baker & Simon, *supra* note 51 at 7.

lematic."[112] The comparison to mountaineering is an interesting contrast to this lack of risk tolerance for casualties that occur in the line of duty, such as soldiers or astronauts. This contrast speaks to differences in which behaviors are being subjectively valued by society.[113] A reevaluation of the cost of risk and high likelihood of catastrophes has caused a shift toward prevention taking precedence over compensation.[114]

Evolution of Risk Society

Francois Ewald, a well-known expert in the field of insurance and risk and former colleague of Michel Foucault, identified a shifting society dynamic over the past centuries; while the nineteenth century focused on individual responsibility, there was a transition to a vision of solidarity in the twentieth century. At the beginning of the twenty-first century, this paradigm has shifted again. "The paradigm of responsibility posits a certain economy of rights and duties in which the part played by moral obligations toward oneself and others is far greater than that of legal obligations."[115] On the other hand, solidarity has greater emphasis on the role of legal obligations, which in this paradigm share more overlap with moral obligations.[116]

Ewald maintains solidarity is not based on fault or liability, but on apportioning the effect of risk.[117] "Solidarity had almost made us riskophiles, now we are almost riskophobes, indi-

[112] Ewald, *supra* note 62 at 297.
[113] Simon, *supra* note 36 at 184.
[114] Ewald, *supra* note 62 at 296.
[115] Ewald, *supra* note 62 at 273.
[116] *Ibid*.
[117] *Ibid* at 277.

vidually and collectively, and will likely remain so for some time."[118] While risk is a social contract based on situational statistics and probabilities,[119] "[r]isk society is composed of intersecting institutions that organize in relation to the production and distribution of knowledge and risk."[120] In a positive light, risk society can be viewed as an expansion of choice that comes along with technological advancement.[121] Though we may not be able to take fully preventative actions, we have sufficient knowledge and understanding to act with a precautionary attitude. One suggestion is that the most effective way to deal with growing manufactured risks is through use of the precautionary principle.[122]

The precautionary principle has two major elements: scientific uncertainty and the possibility of harm that is both serious and irreversible.[123] An irreversible injury is always serious, but a serious injury is not always irreversible. The precautionary principle first emerged in the Brundtland Report on sustainable development in 1987,[124] based on the philosophical underpinnings established by Hans Jonas.[125] It has traditionally been applied in the field of environmental law, where it has been repeatedly included in a series of international instruments[126] and pieces of domestic legislation.[127] In an era where threats are beyond appropriate

[118] *Ibid* at 299.
[119] *Ibid* at 278.
[120] Ericson et al, *supra* note 38.
[121] Giddens, *supra* note 57 at 5.
[122] *Ibid* at 8.
[123] Ewald, *supra* note 62 at 283-284.
[124] *Ibid* at 283; Report of the World Commission on Environment and Development: Our Common Future [Brundtland Report], online: <http://www.un-documents.net/our-common-future.pdf>.
[125] Ewald, *supra* note 62 at 291; Hans Jonas, The Imperative of Responsibility: In Search of an Ethics for the Technological Age (Chicago: University of Chicago Press, 1985).
[126] See, for example, Rio Declaration on Environment and Development, UN Doc A/CONF.151/5 (14 June 1992); see, for a list, Arie Trouwborst, Evolution and Status of the Precautionary Principle in International Law (New York: Kluwer, 2002) at 303-345.

compensation, it leads to an environment where precaution is achieved through prevention.[128] The precautionary principle[129] mandates the application of precautionary measures where an activity could cause harm, even when there is a lack of scientific evidence of the extent or possibility thereof.[130]

While the precautionary principle is not applicable in all circumstances, its use has expanded beyond its original territory of environmental management, for example with the European blood transfusion crisis.[131] For the EU, the Maastricht Treaty sets forth that community environmental policy will be based on the precautionary principle and with a view to take preventative action.[132] Several prominent scholars have argued that the precautionary principle has crystallized into customary international law[133] (which would therefore be theoretically applicable to space activities).[134] for the purposes of this discussion, however, the concept itself is more important than its direct legal applicability, and thus it is not necessary to address this contentious question.

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[127] Gary E. Marchant, "From General Policy to Legal Rule" (2003) 111 Envtl Health Perspectives 1799 & Trouwborst, *supra* note 126 at 178-243.

[128] Beck 2014, *supra* note 35 at 82.

[129] Request for an Examination of the Situation in Accordance with Paragraph 63 of the Court's Judgment of 20 December 1974 in the Nuclear Tests Cases (NZ v Fr), 1995 ICJ 288 (September 22); Gabcikovo-Nagymaros Project (Hung v Slovk), 1997 ICJ 7 at 40-41 (September 25).

[130] Stephanie Joan Mead, "The Precautionary Principle" (2004) 8 NZJ Envtl L 137 at 138.

[131] Ewald, *supra* note 62 at 283.

[132] Treaty on European Union (Consolidated Version), Treaty of Maastricht, 7 February 1992, Official Journal of the European Communities C 235/5, 130.

[133] Owen McIntyre & Thomas Mosedale, "The Precautionary Principle as a Norm of Customary International Law"(1997) 9 J Envtl L 221 at 241; James Cameron & Juli Abouchar, "The Status of the Precautionary Principle in International Law" in David Freestone & Ellen Hey eds, The Precautionary Principle and International Law 29 (New York: Kluwer, 1996). For a discussion of customary international law, see Chapter 4.

[134] Outer Space Treaty, *supra* note 16, art III.

In fact, the very basis of the precautionary hypothesis is the uncertainty in the relationship of causality and it is not always helpful or even necessarily applicable to managing problems of responsibility.[135] "Precautionary logic does not cover risk (which is covered by prevention); it applies to what is uncertain – that is, to what one can apprehend without being able to assess."[136] The precautionary principle does not prescribe all possible precautionary activity, but those that are both effective and proportionate at an economically acceptable cost.[137]

In its basic form, the precautionary principle does something that insurance does inherently: measure an action against the worst-case scenario in the pursuit of avoiding that scenario.[138] Prevention comes with the ability to understand risks and their probability; it requires a certain confidence in the existing knowledge.[139] Development risk emerges in the self-awareness of scientific discoveries contrasted with the obvious limits of our own knowledge.[140] When the risk of development becomes clear, the opportunity for precaution has generally already passed.

The precautionary framework inherently implies motives that are international in nature, rather than tied to any one State or region.[141] This causes the principle to apply smoothly to the space arena, where activities are to be carried out in the interests of and for the benefit

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135 Giddens, *supra* note 57 at 9.
136 Ewald, *supra* note 62 at 286.
137 *Ibid* at 286-287
138 *Ibid* at 292.
139 *Ibid* at 293.
140 Ewald, *supra* note 62 at 290.
141 *Ibid* at 293.

of all mankind.[142] International law has been the home of the precautionary principle, particularly the subfields of international law, trade law, and government liability.[143]

Precaution is a contentious issue in global society because of the inherent power implications;[144] for example, the early space powers were not subjected to the precautionary requirements that emerging actors may be forced to respect in the future, which could have a discriminatory impact in violation of the Outer Space Treaty. In fact, in some cases it is necessary to seek boldness rather than precaution to support scientific innovation and technological change.[145] Like so many other areas of the law, we are looking at a balancing test when deciding whether or not to apply the precautionary principle to a given set of activities.

The three attitudes towards uncertainty that are discussed in this section: responsibility for consequences (legal and financial), solidarity (risk-spreading), and precaution (described in detail in the above paragraphs), are not supplanting each other but complementing each other as they develop and as society shifts. Where fault and obligation are at play, it is reasonable to hold actors to a standard of conduct, respecting the practical consequences of available knowledge.[146] In order to understand the evolution of industry standards and best practices as well as insurance terms and conditions, one must understand all three of the attitudes towards uncertainty and how they work together. It is through this comprehensive understanding that we can see how insurance can act as governance.

142 Outer Space Treaty, *supra* note 16, art 1.
143 Ewald, *supra* note 62 at 295; see also WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) 15 April 2994, 1867 UNTS 493.
144 *Ibid* at 296
145 Giddens, *supra* note 57 at 9.
146 Ewald, *supra* note 62 at 297.

What is the purpose of insurance?

Background work on insurance understands it as a mechanism for spreading risk (future harms for which probabilities are measurable), though insurance is much more than simply a loss spreading mechanism.[147] When individuals desire to be made whole after a loss, organizations with substantial reserves are better positioned to ensure such reparation than others, particularly when such organizations are regulated to require such reserves.[148]

> Risks and chances are to be shared by insurer and insured by determining the probability of certain events happening in the future so precisely that for the insurer on average and over a long period no economic risk and no financial damage are incurred and the insured is still safe-guarded against the unplanned and unforeseeable single event.[149]

The reality is, however, that there is no single, precise definition of insurance.[150] Broadly speaking, it may be possible to think of insurance as an institution of rational providence;[151] the use of math and science to provide divine guidance regarding the outcome of human destiny. These definitions are useful to consider in the following analysis of the purpose of the insurance industry.

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[147] Baker & Simon, *supra* note 51 at 2.

[148] Carol A. Heimer, "Insuring More, Ensuring Less: The Costs and Benefits of Private Regulation through Insurance" in Tom Baker & Jonathan Simon eds, Embracing Risk: The Changing Culture of Insurance and Responsibility (Chicago: University of Chicago Press, 2010) at 130.

[149] Beck 2014, *supra* note 35 at 84.

[150] Baker & Simon, *supra* note 51 at 7; Spencer Kimball, Cases and Materials on Insurance Law (Boston: Little Brown, 1992) at xxv.

[151] Ewald, *supra* note 62 at 277.

Insurance institutions and technologies influence the perception of individual and social responsibility.[152] In an economic view of insurance, individuals are rational, self-interested actors; insurance modifies the incentives of those individuals. However, in the view of political scientists, insurance defines societal norms and values to shape how individuals view responsibility. In this view, insurance is a political authority possessing power and resources to shape individual outcomes.[153] The mundane transactions of insurance arrangements contribute substantially to defining individual and social responsibility.[154]

Insurance is not available on an equal basis to all actors, which reflects power structures and also social hierarchies. Insurance institutions play a key role in shaping social reality.[155] If the product of an industry is seen as socially worthwhile and beneficial to that community, there will be a push to expand coverage[156] – as there has been a push to expand the commercial space industry in the U.S., which is required to hold third party insurance. As is the case with any risk-bearing activities, insurance is obtained (and in some cases, is required, see Chapter 4 and 8) for space activities. However, insurance depends on whether an activity can be seen to be routinized, predictable and orderly.[157] Government through insurance is most effective when either: activities are orderly and predictable, or when property values are

[152] Tom Baker, "Risk, Insurance, and the Social Construction of Responsibility" in Tom Baker & Jonathan Simon eds, Embracing Risk: The Changing Culture of Insurance and Responsibility (Chicago: University of Chicago Press, 2010) at 28.
[153] Deborah Stone "Beyond Moral Hazard: Insurance as Moral Opportunity" in Tom Baker & Jonathan Simon eds, Embracing Risk: The Changing Culture of Insurance and Responsibility (Chicago: University of Chicago Press, 2010) at 70.
[154] Ericson et al, *supra* note 38 at 50; Tom Baker "On the Geneaology of Moral Hazard" (1996) 75:2 Tex L Rev 237 at 291.
[155] Baker 2010, *supra* note 152 at 32.
[156] Stone, *supra* note 152 at 70.
[157] Heimer, *supra* note 148 at 134.

particularly high.[158] Space activities obviously do not fall into that first category, but can easily fall into the second category.

The below table provides a description of the four major conceptual elements of insurance that serve as the building blocks for the industry. These building blocks are: institutions, forms, technologies, and visions.

Aspects of insurance[159]

Institutions	Private insurance companies, state-run insurance organizations
Forms	Types of insurance, ex.: first party liability, third party liability, data breach
Technologies	Underwriting classifications, inspection procedures, actuarial tables, administrative review, standard form policy wordings, self-insurance procedures
Visions	Ideas about, images of, discursive practices regarding insurance – philosophical and moral background of insurance

[158] *Ibid* at 135.
[159] Baker & Simon, *supra* note 51 at 7 & Francois Ewald "Insurance and Risk" in Graham Burchell, Colin Gordon, & Peter Miller eds, The Foucault Effect: Studies in Governmentality (Chicago: University of Chicago, 1991) 197.

In the category of *visions,* the actuarial vision of insurance is so pervasive that many would assert that it is the signature model of insurance rather than a vision of insurance;[160] the idea that the future can be mathematically predicted. Where the law of large numbers can be relied upon, in the aggregate there is very little uncertainty in insurance contracts.[161] "Insurance has long been presented as the science of providence[;]"[162] use of actuarialism to chart human destiny. There are, however, limits to actuarialism – limits in scientific understanding and technological advancement make it difficult to predict certain risks, which make them harder to insure.[163]

Insurance is a tool for communities to improve opportunities for the group as a whole, as well as for individual members.[164] While State-provided insurance can clearly serve this public good, even private insurance provides legitimacy to the idea of mutual interdependence and help – solidarity in the face of risk.[165] Likewise, insurance influences group behavior and character by creating vested interests and thereby increasing psychological (as well as financial) investment and improving opportunities for the community – inducing its individual members to behave in a certain way. Even though commercial insurance may be based in a desire for private financial gain, it benefits from institutional embeddedness; it is known and familiar.[166] Commercial insurance is therefore positioned to provide a public good, even if it

[160] Baker & Simon, *supra* note 51 at 10.
[161] Baker 2010, *supra* note 152 at 36; see *infra,* FN 612.
[162] Ewald, *supra* note 62 at 293.
[163] Ericson et al, *supra* note 38 at 8.
[164] Stone, *supra* note 153 at 54.
[165] *Ibid* at 57.
[166] Heimer, *supra* note 148 at 125.

is done in a for-profit context; communities can benefit and feel comfortable in the understanding of that benefit, even at a superficial level.

Theoretical Approach

Insurance is a system that underwrites the inevitable cost of activities that are deemed to be socially worthy to enable the sharing of losses. In this sense, it has played an enormous role in governance as an alternative to other methods of regulating hazardous activities.[167] The rise of the insurance state is based on the idea that institutions of social insurance can spread losses more evenly.[168] As far as twentieth century governance is concerned, insurance is "the sleeping giant of power."[169] Though it may operate in the background, insurance is implanted in the day-to-day functioning of society.[170] Risk creates and socializes responsibilities, while insurance not only transfers and distributes risk, but also transfers and distributes responsibility.[171]

The chart below provides a summary of the nine dimensions of insurance as governance from a general perspective. These principles are equally applicable in this sector and should be taken into account when determining whether this approach is suitable for our industry.

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[167] Jonathan Simon "Driving Governmentality: Automobile Accidents, Insurance, and the Challenge of Social Order in the Inter-War Years, 1919-2941" (1997-1998) 4 Conn Insurance LJ 521 at 563-567; Stone, *supra* note 153 at 62.
[168] Baker & Simon, *supra* note 51 at 7.
[169] *Ibid* at 12.
[170] Ericson et al, *supra* note 38 at 3.
[171] Baker 2010, *supra* note 152 at 33.

The Nine Dimensions of Insurance as Governance[172]

Knowledge of risk	Objectifying into degrees of chance of harm
Calculable objects	Actuarialism produces probability classifications that are assigned respective costs
Risk pool	Population with a stake in specified risks and harms, thus collective interest
Protection	Protects against loss of capital, not the occurrence of the event
Managerial behavior	Utilizes surveillance and audit
Legally binding	Assignment of liability, contractual agreement, possibility of adjudication
Cultural framework	Futures market in security impacts concepts of time, destiny, providence, responsibility, economic utility, justice
Social technology of justice	Distributive justice and restorative justice contribute to responsibility
Political tension	Combines aspects of collective well-being and individual liberty

As one can see, knowledge of risk (technological and social), calculability of risk, population with stake in that risk, protection of entity and industry financial viability, surveillance and auditing functions, clarity of liability and contractual provisions, cultural value of risk, ability

[172] Ericson et al, *supra* note 38 at 5-6; 47-49.

to restore injured parties to their earlier state, and political tensions apply equally well to space insurance as to other insurance sectors to which we have applied this approach.

Robert Cover, late imminent legal scholar on the faculty at Yale, developed the concept of a "nomos" – a community of people who are joined by their ethical commitments that provide the basis for their normative lawmaking.[173] It is ethical for those who injure or damage the property of others through their actions to attempt to compensate those who are injured or damaged. It is also ethical to conduct one's activities in such a way to not unduly endanger the activities of others. As analyzed subsequently in this thesis, these principles are enshrined, from a space law perspective, in Articles VII and IX of the Outer Space Treaty and in the Liability Convention.

In this vein, as a form of delegated state power, States can mandate that an individual (whether natural or juridical) wishing to participate in a certain activity obtain certain insurance in order to do so;[174] third party insurance is required by many States' domestic space law regimes. As insurance is legally necessary for some institutions and financially necessary for others, it plays a key role in space activities. The importance of space insurances allows a comparison of the insurance industry as a regulatory institution to other institutional arrangements for risk sharing.[175]

The concepts of insurance and social control are intertwined. If the insured has a higher degree of control over the potential loss, the insurer places more requirements on the insured.[176] In order to control losses in the form of insurance claims, insurers will create their

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[173] Robert Cover, "Nomos and Narrative" (1983-1984) 97 Harvard L Rev 4.
[174] Baker & Simon, *supra* note 51 at 13.
[175] Heimer, *supra* note 148 at 119-120.
[176] Baker 2010, *supra* note 152 at 44.

own conduct norms that are enforced in accordance with their contact terms and pricing models.[177] Though people tend not to consider the ways in which they are governed by insurance,[178] insurance is a form of discipline as defined by Foucauldian scholars. It provides a system to establish norms, supervise behavior, and enforce compliance with those established norms.[179] "A sociology of risk and insurance invites an interdisciplinary discussion and debate about the complex relation between risk, responsibility, insurance, and governance."[180] The phenomenon of "normalizing judgement" identified by Michel Foucault, consists of one party evaluating the performance of another that is systematically connected to training and rewards, reflected the influence that disciplinary technologies have had on society.[181]

Francois Ewald helps to explain how insurance functions as a form of government.[182] Formal insurance casts a regulatory shadow similar to the one cast by the law, but the size and shape of those shadows vary substantially between locations.[183] The insurance industry, with minimal visibility, holds a great deal of control over institutions and individuals in modern society. It is in this way that insurance acts as government.[184] The insurance industry recruits and selects who it considers members after collecting detailed knowledge about them; it manages this population in order to motivate, mobilize, and manage them; it gives them incentives to enhance their risk ratings.[185] In other words, insurers are motivated to increase

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[177] Baker & Simon, *supra* note 51 at 13.
[178] Ericson et al, *supra* note 38 at 53.
[179] Simon, *supra* note 36; Stone, *supra* note 153 at 62.
[180] Baker & Simon, *supra* note 51 at 176.
[181] Simon, *supra* note 36 at 197; Michel Foucault, Discipline and Punish: The Birth of the Prison (New York: Pantheon, 1977) at 177-184.
[182] Baker & Simon, *supra* note 51 at 17.
[183] Heimer, *supra* note 148 at 134.
[184] Ericson et al, *supra* note 38 at i.
[185] Ericson et al, *supra* note 38 at 29.

profitability by encouraging insureds to reduce risk. These are also techniques that Foucault applied in a state context as biopower, discipline, and sovereign power.[186]

Regardless of whether insurance is compulsory or obtained due to institutional prudence, it is still a form of regulation. In fact, "insurance is one of the greatest sources of regulatory authority over private life."[187] Insurers have had such great success in implementing insurance incentives that it is possible that a greater moral hazard effect (increased social control on the part of insurers – entities without democratic authority) could occur.[188] From a technical perspective, insurance (as a contract) creates standards of behavior; from a theoretical perspective insurance as governance concentrates on regulating moral risks.[189] Rather than being an immoral choice (to escape responsibility or liability for one's actions), insurance as a function of collective responsibility makes it a moral choice.[190] Social mechanisms are created by insurance that shape what is perceived as insurable or deserving of solidarity.[191]

Though the collective nature of insurance may be obscure to policy holders, particularly in private insurance, it is still a reality.[192] The consumers of insurance are actually also part of the product, in that they are in the risk pool on which the financial solvency of the insurance industry is based.[193]

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[186] Graham Burchell, Colin Gordon, & Peter Miller eds, The Foucault Effect: Studies in Governmentality (Chicago: University of Chicago, 1991).
[187] Baker & Simon, *supra* note 51 at 13.
[188] Tom Baker "On the Geneaology of Moral Hazard" (1996) 75:2 Tex L Rev 237.
[189] Ericson et al, *supra* note 38 at 10.
[190] Stone, *supra* note 153 at 53.
[191] *Ibid* at 53.
[192] *Ibid* at 55.
[193] Ericson et al, *supra* note 38 at 5.

There exists a line of scholars in traditional insurance fields who argue that insurance should never be mandatory on the basis that not everyone accepts the moral assumptions of collective responsibility or individual responsibility for the well-being of others.[194] For example, "whether or not those purchasing real estate would wish to buy title insurance becomes irrelevant when mortgage companies make title insurance a condition of securing a mortgage."[195] Mortgage companies, however, still exercise a non-State regulatory power in enforcing these rules. Insurance is not only sometimes legally mandated, but it is often required as part of a private contract. When standards of insurance in certain types of contract deals become near-universal, it is no longer relevant that the insurance is not legally mandated.[196] With regard to space activities, this issue is relevant for oft-required third party insurance.

Heimer argues that this sort of mandatory insurance undermines social ties and makes relationships irrelevant by replacing risk-mitigating behavior with insurance that indemnifies against losses.[197] While this author recognizes how this problem is possible in theory, it seems unlikely to be a realistic outcome in this particular context. The responsibility for avoiding this issue falls both on the drafters of insurance contracts and the legislators and judges responsible for the formation and interpretation of the law. It is wise drafting to prevent insureds from engaging in risky behavior simply because they have insurance, as this would create undue financial risk to the insurer as well as a moral hazard. It is up to legisla-

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[194] Stone, *supra* note 153 at 63. Richard A. Epstein, Mortal Peril: Our Inalienable Right to Health Care (Reading, MA: Addison-Wesley, 1997); Max Skidmore, Social Security and Its Enemies (Boulder: Westview Press, 1999).
[195] Heimer, *supra* note 148 at 125.
[196] *Ibid* at 126.
[197] *Ibid* at 123.

tors and judges to create and enforce the law in the spirit of the public policy context in which it is created. Therefore, much like it is impossible in most jurisdictions to waive liability for grossly negligent or intentional behavior, it should be impossible to contract away morally reprehensible or reckless behavior through insurance.

One of the critical elements of governance through insurance is expertise; experts employed by insurance companies are responsible for many technological developments in risk assessment, such as genetic testing.[198] Arguably more importantly to the space industry, insurance experts provide insureds with the tools to prevent certain risks. Those who provide services to insurers are also governed through surveillance and accountability.[199]

The following chart provides an easy reference point for the ways in which insurance can act as a governing institution. Private insurance in many ways acts similarly to the State in any given narrow field in a variety of ways; it shares goals, uses similar methodologies, and is subject to the same social forces. Additionally, insurers partner with States in a number of areas of governance.

[198] Ericson et al, *supra* note 38 at 54.
[199] *Ibid* at 54.

How is the insurance industry an institution of governance?[200]

Private insurance shares many goals with the State	-pools risk to achieve social security -pursues preventative security arrangements in order to reduce losses and minimize harm -facilitates choices through contracts
Private insurance uses many of the same methodologies as the State	-uses surveillance for population management -develops sophisticated systems to select risks and compensate losses -mobilizes professional knowledge and experience -possesses private policing apparatus
Private insurance is subject to many of the same social forces as the State	-must constantly anticipate and monitor the changing risk environment, facing massive consequences -subject to substantial institutional shift and reorganization
Private insurance partners with the State to regulate insurance practices	-contributes investment capital in the political economy -Insurers regulate insureds much in the same way that the State regulates insurers -State and insurance both regulate insured professions and activities
Private insurance partners with the State to develop technologies insuring individual responsibility for risks	-mutual interest of the State and insurers makes individuals risk managers and risk takers subject to regimentation and discipline

Applying this same analysis to the space insurance industry shows that this theory is applicable here. Insurers pool risk, particularly under the Lloyd's model discussed in Chapter 3 and utilizing reinsurance, to achieve security in an industry where a single loss could be cata-

[200] Ericson et al, *supra* note 38 at 45-46.

strophic. Although third party insurance is mandatory, a wide range of choices are available in the form of first party liability coverage (and second party liability options will become available as spaceflight participants begin traveling on space vehicles). The insurers possess technical and actuarial expertise to help asses the risks and ensure that their clients are meeting their obligations through sharing of relevant technical documents, etc. The space insurance industry and risk environment are continually evolving as new technologies are developed and flaws are discovered in existing technologies, causing failures and losses. The space industry, and therefore the space insurance industry, will remain most viable if through constant movement forward of technologies and techniques for managing risks. All-in-all, insurers can follow-on from minimalist international or State regulation to refine applicable standards, acting as a quasi-partner to the state.

Now that the fundamentals of the concept of insurance as governance have been established, one must ask the next question: whether insurers are governing through insurance or governing for insurance?[201]

> "Insurers may simply fill a regulatory void, bringing order to a field in which other regulators have shown little interest, or they may regulate at the invitation of the state, in an arrangement that resembles the hiring of contractors to supply services that the state does not itself with to supply, or they may enter the political fray, actively opposing state attempts to regulate, particularly when citizen interest or outrage encourages states to enter areas previously left to insurers"[202]

In the three instances articulated above, the answer to this question will be different. Governing at the invitation of the State (such as a regulatory requirement to obtain certain coverage) is a form of governing through insurance, while opposing State attempts to regulate in favor

201 Heimer, *supra* note 148 at 136.
202 *Ibid* at 132.

of maintaining insurer-led regulation is an example of governing for insurance. Insurers filling a regulatory void can be governing through insurance, governing for insurance, or both, depending on the substantive provisions that are applied.

Conclusion

In many States, insurers are given the power to regulate at the invitation of the State by setting terms for their mandatory policies (in the case of space, usually third-party launch insurance). As one such particularly important example, the insurance requirements of the United States are discussed in more detail in Chapter 7. For some further examples, Australia imposes an insurance requirement for either 750 million AUD or maximum probably loss (MPL),[203] the United Kingdom imposes a requirement based on the mission (single satellite missions on established launchers using established technology usually only require 60 million euro),[204] South Korea and Brazil set requirements based on the case-by-case analysis of each launch,[205] China requires a policy of insurance in compliance with their national regula-

[203] Australia Space Activities Act 1998, Division 7, *Insurance/financial requirements* §§ 47-49, online: Australian Government, <https://www.legislation.gov.au/Details/C2004C01013>.

[204] Revised Guidance For Applicants, Outer Space Act 1986/Deregulation Act 2015, online: United Kingdom government, <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/464931/Guidance_for_applicants_-_October_2015.pdf> at 2.

[205] Republic of Korea, Space Development Promotion Act, arts 5, 6, 11; see Doo Hwan Kim "Space Law and Policy in the Republic of Korea online: UNOOSA, <http://www.unoosa.org/pdf/pres/2010/SLW2010/02-09.pdf> at 10. For Brazil's legislation, see Administrative Edict N. 27 of June 20th 2001, Ministry of Science and Technology, Brazilian Space Agency, online: Associação Brasileira de Direito Aeronáutico e Espacial, <http://www.sbda.org.br/textos/DirEsp/Portaria%2027_AEB_2001_E.pdf>, Art 9.III.

tions.[206] Russia and the Ukraine set minimum insurance requirements in their domestic legislation as well.[207] There is also, however, a regulatory void to be filled where States, such as the U.S., have held off on more regulation for fear of stunting industry development and losing competitive advantage. In this instance, insurers are able to regulate across borders, limiting the potential for harm to the industry of any one State. While this is certainly governing through insurance, there is likely to be an element of governing for insurance that can be counter-productive. For example, if the statistical probability of a collision with an individual insured space object is sufficiently low, it may not be considered worthwhile from an insurance perspective to implement more substantial debris mitigation requirements, even if they would be beneficial for the sustainability of the space environment.[208] Thus, this chapter has established the ways in which insurance *can* act as governance for the space industry.

In this author's view, the benefits of insurance acting in that role outweigh the downsides and therefore the insurance industry *should* act in that capacity with knowledge and intent when they are motivated to do so. By the nature of their risk management activities, insurers participate in regulating industries whether they intend to do so or not. The governance role provided by insurers will be more effective and efficient if it is carried out thoughtfully and with intent, rather than simply as an unconsidered by-product of their activities.

Though well-developed government regulations are superior to market-driven insurance-based regulation due to increased legitimacy, transparency, and universality, govern-

[206] Order No. 12 of the Commission of Science, Technology and Industry for National Defense of the People's Republic of China, 21 November 2002, Art 19, republished in (2007) 33:2 J Space L 442 at 446.
[207] Law of the Russian Federation About Space Activity, Decree No. 5663-1 Art 25, Ordinance of the Supreme Soviet of Ukraine on Space Activity, Nov. 15, 1996, Art 24 § IV-B.Russia.1-7 & § IV.B.Ukraine.1-1 in Paul Stephen Dempsey ed *Space Law* (2004).
[208] Author conversation with Denis Bensoussan (Beazley); 16 Oct 2015.

ment regulations are difficult to change and should only be implemented when the industry is sufficiently mature to exist under a static regulatory environment. Insurers can change their requirements and incentives year to year, and thus have much greater opportunity to fine tune those elements which will provide the greatest benefits in terms of risk minimization in exchange for the lowest costs to the insured. When the industry has matured, government can step in to regulate, taking advantage of the lessons learned by the insurance industry in the process. In the meantime, the industry can benefit from the technical expertise that is being maintained at the insurer level, which can inherently adapt more quickly to the changing technologies.

Chapter 3: The State of Space Insurance

Introduction

This brief chapter exists to provide context for the remainder of the thesis. In order to undertake complex critical analysis of how the legal and regulatory context impacts space insurance, it is necessary to understand how the insurance industry in general, and the space insurance industry in particular, function. Thus, this chapter concisely provides the review necessary for that understanding, though it is the only chapter that does not directly address any part of the research question directly.

Key Actors

The bilateral contract that constitutes insurance is, in reality, dependent on the group of other insureds.[209] A massive regulatory apparatus exists to minimize avoidable loss. This apparatus effects not only the insureds, but also brokers, insurers, industry groups, and so forth.[210] The private legal practitioner who is involved in liability and insurance for commercial space transportation is meant to advise clients on risk management; these clients can be launch services providers, contractors and sub-contractors of launch services providers, users of space transportation services (provider of the payload to be launched) and / or insurance brokers.[211] The methods for managing risk for these participants include contract terms with incentives or penalties, surveillance methods, modified design for safety and security, etc.[212]

[209] Baker 2010, *supra* note 152 at 37.
[210] Ericson et al, *supra* note 38 at 11.
[211] Nesgos 1989, *supra* note 75 at 21-22.
[212] Ericson et al, *supra* note 38 at 11-12.

When an insurance company decides how much financial responsibility to assume with regard to any particular risk, it parcels out the remainder of the responsibilities to other actors.[213] It is worth noting that aerospace corporations that are fulfilling government contracts, for example for the provision of scientific or military missions, are subject to different contractual regimes than purely commercial launch services.[214]

The Lloyd's Model

Lloyd's of London, which started as a maritime insurer but now provides a wide range of insurance coverages, provides an interesting and highly evolved model for insuring high risk ventures. The quota-sharing regime that allows risk-sharing among syndicates (and "names") enables the writing of insurance for very large risks, with less risk to the individual underwriter. It also allows those underwriters with particular expertise in an area to take the lead, demonstrating to insurers with less expertise that it is safe to take on a piece of that risk's pie.

Space insurance has become an important market sector for Lloyd's.[215] Lloyd's (as well as smaller insurance institutions) could be severely damaged at any point by yet unforeseen consequences of technological advancement or scientific findings.[216] If an entire risk were to be underwritten by a single entity, the loss of a single large telecommunications satellite could cause severe financial difficulty for that entity, while the other members of the insur-

213 Baker 2010, *supra* note 152 at 38.
214 Nesgos 1989, *supra* note 75 at 22.
215 Robin Gubby, David Wade, & David Hoffer, "Preparing for the Worst: The Space Insurance Market's Realistic Disaster Scenarios" (2015) 3:XX New Space 1 at 1.
216 Giddens, *supra* note 57 at 2.

ance market would remain untouched. With the Lloyd's model, no one company will bear the full brunt and consequences of a single very high value loss, thus the financial viability and sustainability of the venture (and the market as a whole) is easier to preserve.

There is a fundamental difference between the Lloyd's insurance market and the U.S. financial guarantee market – the U.S. market is concerned with investment grade security transactions and thus is more risk averse and prone to maintaining low premiums with high insured sums, whereas the London market is more diverse and takes on more real risks with higher premium rates.[217] The London marketplace is quite used to dealing with difficult risks that require manuscripted wordings.[218] Though the London market is a leader in the space insurance industry, aviation (including aerospace) made up only approximately 6% of Lloyd's gross premium in 2015.[219]

[217] HIH Casualty & General Insurance Ltd. V New Hampshire Insurance Co [2001] Lloyd's Rep IR 596 para 200.
[218] Christopher Henley, Drafting Insurance Contracts (London: Leadenhall Press, 2010) at 69.
[219] "London Company Market Statistics Report 2016" online: International Underwriting Association, <https://www.iua.co.uk/IUA_Member/Publications/London_Company_Market_Statistics_Report.aspx> at 5 & 10.

Types Of Insurance

Types of Liability Insurance

Generally speaking, there are three main types of liability – first, second, and third party. The party to the contract for space insurance will be one bearing the risk of loss.[220] "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."[221] 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.[222] Generally a loss will be covered if the status of the satellite fulfills loss definitions in the insurance contract and satellite or a portion thereof cannot be used for its intended purpose.[223] The sums insured can range from as little as USD 10 million to as much as USD 450 million.[224]

Insurance for second party liability has thus far been less relevant in the space arena, as it would cover passenger liability, though such offerings are on the horizon. As paid space flight participant voyages have not yet commenced, this is an emerging area of space insur-

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[220] Philippe Montpert, "Space Insurance" in Contracting for Space, Lesley Jane Smith & Ingo Baumann, eds (Burlington: Ashgate, 2012) at 286.
[221] Abeyratne 2003, *supra* note 18 at 191.
[222] Montpert, *supra* note 220 at 285.
[223] *Ibid* at 286.
[224] *Ibid* at 287.

ance. It bears similarities to insurance for passenger liability in aviation, for example. Commercial operators can require spaceflight participants (non-crew) to maintain a certain level of insurance in order to participate,[225] which would be a wise move going forward. It is worth noting that insurance for second party liability is not called second party insurance, as the second party to an insurance contract is the insurer. Second party refers to another party sharing contractual privity; therefore, while a spaceflight participant is a second party with regard to the insured, they are a third party from the perspective of the insurer. Regardless, the insurance contract itself will provide details regarding who can be covered for losses under the particular contract (i.e., if participants are exluded or included).

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.[226] Aside from the Cosmos 954 negotiation between Russia and Canada – resulting from the deorbit of a defunct Russian nuclear-powered satellite causing damage in Canadian territory - 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.[227] Thus, this is a low probability area of accidents with high potential losses.

Third-party insurance is the aspect of insurance that can most strongly establish an expectation of community aid. It is carried specifically to pay for damage and losses caused

[225] Pamela Meredith and Marshall Lammers, "Commercial Spaceflight: The Ticket to Ride" (2013) ABA Air & Sp J at 7.
[226] Matthew Schaefer, "The Need for Federal Preemption and International Negotiations Regarding Liability Caps and Waivers of Liability in the US Commercial Space Industry" (2015) 33:1 Berkeley J Int'l L 223 at 225.
[227] Montpert, *supra* note 220 at 284.

to others. This is not ignoring the fact that it protects the insured party from losses due to adverse judgments. It does, however, ensure responsibility to others and provide an organized institution for doing so.[228]

Insurance Phases

Space insurance policies are often referred to as "all risk" policies, though critically, they are not "all loss" policies.[229] These "all risk" policies are also known as "all perils" policies.[230] 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. [231] Generally, this phase of insurance ends when upon first ignition of the launch vehicle or at the point when the launch process becomes irreversible.[232]

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[228] Stone, *supra* note 153 at 61.
[229] Stephen Tucker, "Some Strategic Defense Initiatives Toward Preventing U.S. Space Insurance Related Disputes and Litigation" (1993) 21 J Space L 123 at 126; Gaubert, Cecile, "Insurance in the Context of Space Activities" in Frans von der Dunk & Fabio Tronchetti eds, Handbook of Space Law (Northampton: Edward Elgar, 2015) 910 at 932.

[230] Gubby et al, *supra* note 215 at 2.
[231] Gabriella Catalano Sgrosso, International Space Law (Florence: 2011, LoGisma) at 491-492.
[232] Montpert, *supra* note 220 at 283.

The highest premium cost and riskiest phase of insurance is the launch phase. It costs about an order of magnitude more than in-orbit rates.[233] 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. It covers launch failures, electrical failures, mechanical failures, and any debris or meteoroid strikes or loss caused by space weather that may occur during this period.[234] 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. The in-orbit life for a satellite can be more than fifteen years.[235] There can be partial or total losses 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.[236] The percentage of premium rate for each phase is determined by the probability of failure in that phase.[237]

Availability of Space Insurance

About thirty satellite launches are insured per year, which is in addition to the over 200 satellites insured on-orbit.[238] Only about 50% of commercial satellites in orbit and about 20% of all active satellites in orbit are insured,[239] this is largely due to the historically high number of military and other State satellites and satellites self-insured by major telecommu-

[233] Gubby et al, *supra* note 215 at 2.
[234] *Ibid* at 2.
[235] Gubby et al, *supra* note 215 at 2.
[236] Sgrosso, *supra* note 231 at 492-493.
[237] Montpert, *supra* note 220 at 283.
[238] Gubby et al, *supra* note 215 at 1.
[239] *Ibid* at 1.

nications companies. While geostationary launch numbers are expected to remain stable, non-GSO launches, particularly commercial launches, are expected to increase substantially in the next few years.[240]

Though premium rates for space insurance had been declining as the technology was demonstrating increased hardware reliability, this has been offset by 2013 and 2014, which were the first money losing years for the space insurance sector since 2007[241] and according to the November 2016 report, the 2015 failures seem to have led to another losing year for space insurers.[242] More than $800 million in claims were anticipated for the 2014 policy year; this includes $48 million for Orbital Sciences, $214 million for Asia Broadcast Satellite-2, $199 million for Amazonas 4A, and Russia's Express-AM4R for $225.4 million.[243] Despite the failures in 2014, governments have embraced policies intended to stimulate the space sector including both the U.S., as detailed in a subsequent chapter, and the U.K., which agreed to implement industry recommendations reducing satellite third party damage insurance requirements by 25%,[244] opening up the equivalent amount of market capacity.

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[240] Commercial Space Transportation Forecasts 2015, online: FAA, <https://www.faa.gov/about/office_org/headquarters_offices/ast/media/Commercial_Space_Transportation_Forecasts_2015.pdf>.
[241] Cenan Al-Ekabi, "Space Policies, Issues and Trends in 2014-2015" European Space Policy Institute (November 2015) at 2.3.5.
[242] Cenan Al-Ekabi, "Space Policies, Issues and Trends in 2015-2016" European Space Policy Institute (November 2016) at 2.3.5.
[243] "SpaceNews 2014 Year in Review" 26 December 2014 online: SpaceNews, <http://spacenews.com/spacenews-2014-year-in-review/>.
[244] Peter B. DeSelding, "Britain to Reduce Space Insurance Requirements, May Ease Small-sat Licensing Rules" (30 April 2014) online: SpaceNews, <http://spacenews.com/40417britain-to-reduce-space-insurance-requirements-may-ease-smallsat-licensing/>.

Conclusion

In general, it is worth establishing the insurer priorities relevant to actions taken by that industry segment. This author has provided the chart below as an easy visual aid to consider in reflecting on the space insurance industry, though it is relevant to other fields of insurance as well. These priorities can be broadly classified as trustworthiness, accountability, causality, freedom and solidarity. In an industry with such large, potentially catastrophic losses, trustworthiness and accountability are of particular importance to insurers. Trustworthiness encompasses not only the moral trustworthiness of the insured, but also the trustworthiness of the technology being utilized in their space launches.

The chart on the following page summarizes subjective insurer priorities, more specifically their interests in trustworthiness, accountability, causality, freedom, and solidarity. While insurer concerns in these areas may be technocratic in nature (more so than the correlative government concerns), they do contribute to the transparency and accountability of insurer-led governance and can help assuage concerns relating to these particular areas.

Insurer Priorities

Trustworthiness	Decisions about acceptable insureds, premiums charged, claims management, risk-management techniques
Accountability	Decisions regarding premiums/benefits, subrogation, risk-management techniques
Causality	Decisions about which claims to pay and what types of benefits are offered
Freedom	Efforts to control moral hazard
Solidarity	Decisions about risk classification and underwriting and risk-management techniques

This chapter has provided a context for analysis of the primary research questions, demonstrating who the key actors in the industry are, how space insurance works, and what kinds of statistics we typically see with regard to space activities. With this information in mind, it is possible to move on to a critical analysis of the relevant conflicts and gaps in the space law regime.

Chapter 4: International Space Law in Context

Introduction

Commercial space actors have to face a variety of hurdles before they can obtain insurance and successfully engage in space activities. These hurdles can be legal, regulatory, financial, technological, or operational in nature. This chapter focuses on the legal and regulatory issues, though these necessarily often implicate financial and operational concerns, and attempts to demonstrate the extent to which these hurdles are not insurmountable, providing they are tackled with the appropriate approach that emphasizes the importance of performing legal and regulatory due diligence early in the process.

Laws and regulations are developed in a particular context. In the case of space, this context is heavily rooted in international law and the understanding that space activities are inherently high-risk activities. Therefore, a doctrinal analysis of the relevant international law is essential. Though there is a great deal of risk involved in participating in such activities, there is also potentially a great deal of reward available, both financially and in terms of prestige, to those individuals and entities who seek participation in the space arena in the near term.

The sources of international space law are the same as those found in international law generally.[245] These sources are articulated in Article 38(1) of the Statute of the International Court of Justice:

[245] P.P.C. Haanappel, The Law and Policy of Air Space and Outer Space: A Comparative Approach (The Hague: Kluwer Law International, 2003) at 183.

> a. international conventions, whether general or particular, establishing rules expressly recognized by the contesting states;
> b. international custom, as evidence of a general practice accepted as law;
> c. the general principles of law recognized by civilized nations;
> d. subject to the provisions of Article 59, judicial decisions and the teachings of the most highly qualified publicists of the various nations, as subsidiary means for the determination of rules of law.[246]

Thus, treaties, customary international law, and general principles of law act as the primary sources of space law, while judicial decisions and the writings of jurists act as subsidiary means for the determination of rules of law. This chapter will use this doctrine and a review of the relevant space law literature in partial answer to the question:

1) From a legal and policy perspective, is there a regulatory void that needs to be filled, at least temporarily?

Treaty Law

Though the international treaties that apply to commercial launch activities do not gain a great deal of attention on a day to day basis, it is important to understand their principles in order to manage the associated liability and insurance issues.[247] The Outer Space Treaty, the oldest and most comprehensive of the treaties governing space law, is the cornerstone of space law.[248] This treaty has been ratified by 105 States and signed by an additional twenty-

[246] Statute of the International Court of Justice, 18 April 1946, 59 Stat. 1031, art 38(1).
[247] Nesgos 1989, *supra* note 75 at 25. It is worth noting, however, that the international treaties have no direct effect on the space insurance market. Matthew Schaefer, "The Intersection of Insurance Markets and Liability Regimes Regarding Third-Parties and Space Flight Participants in Commercial Space Activities" 57th Colloquia of the Laws of Outer Space, International Institute of Space Law (2014) 407.
[248] Francis Lyall & Paul B. Larsen, Space Law: A Treatise (Burlington: Ashgate Publishing

five, demonstrating a high level of acceptance, particularly among States that participate in space activities.[249] All of the major space-faring States are parties to this Treaty. Articles I, II, and III of the Outer Space Treaty are considered to be fundamental principles of space law.[250]

Article I tells us that space is free for the exploration and use of all States, which is to be carried out both for the benefit and in the interests of all States. This principle includes a freedom of scientific investigation, which is to be facilitated and encouraged by international cooperation. This non-discriminatory principle is inherently beneficial for those entities wishing to undertake space activities, as it secures their right (with State authorization, see Article VI and relevant discussion below), to do so. Insurer-led governance can actually positively contribute to the realization of the aspirational principles enshrined in Article I in two meaninful ways. First, for business reasons insurers would prefer to keep space open for the (sustainable) use of all parties, in order to grow their own respective portfolios. Second, where States are inherently biased against their own actors, insurers regulate across State boundaries and discriminate only on risk (which can, unfortunately, still impact insuring decisions with regard to particular States, as those States with more regulatory requirements may require less intensive due diligence on the part of the insurers).

Under Article II of the Outer Space Treaty, space cannot be appropriated by use, occupation, or other means. This includes both "territory" which may be found on celestial bodies, as well as positions in space such as orbital slots. This widely accepted principle can be seen as problematic for the commercial space industry, as it could foreseeably limit the rights of a

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Company, 2009) at 53.

[249] Status of International Agreements Relating to Activities in Outer Space, *supra* note 20 at 12.

[250] IH Ph. Dierdericks-Verschoor, "Space Law as it Effects Domestic Law" (1979) 7 J Space L 39 at 42; Lyall & Larsen, *supra* note 248 at 458.

State or entity which may have invested substantial capital into a space project with the express purpose of utilizing one or more specific areas of space and raises a regulatory risk. While it could be particularly problematic for those seeking to utilize natural resources that are found in space or to set up human settlements in space, it has not yet proved problematic for those States and entities that have substantially invested in geostationary communications. International agreements have been reached to deal with concerns regarding long-term satellite placement.

It is Article III which establishes the unquestionable applicability of international law to the realm of outer space. This Article states that:

> States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding.[251]

General international law is substantially more well-developed and tested than the *lex specialis* of space law, and thus provides a more substantial legal basis for understanding interactions between international or multinational entities in space, as well as the protection of the UN Charter, which is specifically cited by this treaty article. Article 38.1 of the ICJ Statute provides insight into the sources of international law.[252] Therefore, in any discussion of space law, it is important to note other relevant provisions in international law that may have an impact. For the purposes of this thesis, the international regime relating to liability is most relevant.

[251] Outer Space Treaty, *supra* note 16, art III.
[252] ICJ Statute, *supra* note 246.

In addition to international law generally, it is also important to consider that "the law relating to the conclusion, validity, effect, interpretation and discharge of treaties and other international agreements applies to treaties and agreements covering space matters."[253] Though the Vienna Convention on the Law of Treaties came into force after the drafting of the outer space treaties, it can still be applied to the extent that the principles enshrined therein represent rules of customary international law.[254] The International Court of Justice has confirmed that Articles 31 and 32 of the Vienna Convention, the relevant provisions regarding treaty interpretation, represent customary international law.[255] These treaty interpretation rules assist in determining the rules of law applicable under the space treaties.

There is substantial interconnectedness between the treaties. The Return and Rescue Agreement, Liability Convention, and Registration Convention all elaborate specific aspects of the Outer Space Treaty. These conventions, with ninety-five, ninety-four, and sixty-three ratifications respectively (as compared to the Outer Space Treaty's one-hundred-and-five), provide more detailed rules relating to return and rescue, liability, and registration requirements.[256] For one example, registration of a space object performed in conformity with the

[253] C. Jenks, Space Law (London: Stevens & Sons Ltd., 1965) at 205.
[254] M. Fitzmaurice, O. A. Elias & Panos Merkouris, Issues of Treaty Interpretation and the Vienna Convention on the Law of Treaties: 30 Years On (Leiden: Martinus Nijhoff Publishers, 2010) at 5; Steven Freeland & Ram Jakhu, "Article II of the Outer Space Treaty" in Hobe, Schmidt-Tedd, Schrogl eds, Cologne Commentary on Space Law. Volume I: Outer Space Treaty (Carl Heymanns Verlag, Köln, 2010) at 48; see VCLT, *supra* note 110, art 31-32.
[255] Case Concerning the Territorial Dispute (Libyan Arab Jamahiriya v. Chad), Judgment, [1994] ICJ Rep 6 at 41; Case Concerning Maritime Delimitation and Territorial Questions (Qatar v Bahrain), Judgment, [1995] ICJ Rep 6 at 33; Legal Consequences of the Construction of a Wall in the Occupied Palestinian Territory, Advisory Opinion, [2004] ICJ Rep 136 at 94.
[256] Status of International Agreements Relating to Activities in Outer Space, *supra* note 20 at 12.

requirements of the Registration Convention would qualify as a registration to grant jurisdiction and control over the object under Article VIII of the Outer Space Treaty. It is worth noting that, among its myriad functions, the United Nations Office of Outer Space Affairs maintains a database of national space legislation (though that database is not complete),[257] as well as a record of registered launches,[258] and the text and ratification status of all five treaties.[259]

Unlike the Outer Space Treaty, the Return and Rescue Agreement does not offer much benefit to non-space faring States,[260] which may account for the small disparity in ratifications between the two treaties. The Outer Space Treaty protects the rights of States with regard to future space activities, and the Outer Space Treaty and Liability Convention both protect the rights of those States who may be injured by other States' space activities, regardless of whether or not they carry out space activities of their own. The Return and Rescue Agreement, however, only guarantees rights of space-faring States, and incurs obligation without benefit to non-space faring States with regard to those provisions regarding treatment of space objects and astronauts that may reenter and find their way to the territory of these States.

The Moon Agreement, the most recent and least subscribed of the outer space treaties (with a mere seventeen ratifications), provides the least value in terms of binding rules of

257 National Space Law Database. United Nations Office of Outer Space Affairs, online: UNOOSA, <http://www.oosa.unvienna.org/oosa/en/SpaceLaw/national/state-index.html>.
258 Register of Space Objects, U.N. Office of Outer Space Affairs, Online Index of Objects Launched into Outer Space, online: UNOOSA, <http://www.oosa.unvienna.org/oosa/en/osoindex.html>.
259 Status of International Agreements Relating to Activities in Outer Space, *supra* note 20.
260 Roy S.K. Lee, "Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space" in Nandasiri Jasentuliyana & Roy S.K. Lee, eds, Manual on Space Law Volume I (Dobbs Ferry: Oceana Publications, 1979) 53 at 73.

treaty law because the provisions contained within this Agreement bind only those seventeen parties.[261] The Moon Agreement does, in fact, apply to all celestial bodies in the solar system for which no specific international agreement has been reached.[262] Thus, for example, the Moon Agreement would apply to the proposed activities of Dutch company MarsOne on Mars,[263] as the Netherlands is a party to the Agreement.[264]

In-depth analysis of the treaty provisions that are most relevant to our discussion of insurance can be found later in this chapter.

Customary International Law and *Soft Law* Instruments

Customary law, as a component of international law, has a role to play in space law as well. "'[I]nternational custom' means really that part of the applicable rules and norms of the international legal system that is not covered by treaties (sub-paragraph (a)) or the general principles of law (sub-paragraph (c))."[265] Custom can be more difficult to identify than treaty law and, unlike conventions, consists of two elements recognized in Article 38(1)(b) of the Statute of the International Court of Justice [ICJ Statute], namely state practice and *opinio*

[261] Status of International Agreements Relating to Activities in Outer Space, *supra* note 20 at 12.
[262] Moon Agreement, *supra* note 16, art 1(1).
[263] MarsOne, "Mars One Will Settle Men on Mars in 2023 – Press Release" online: Mars One, < http://mars-one.com/en/component/content/article/11-news/284-mars-one-will-settle-men-on-mars-in-2023-press-release?highlight=YToxOntpOjA7czoxMToibmV0aGVybGFuZHMiO30=>
[264] Status of International Agreements Relating to Activities in Outer Space, *supra* note 20 at 9.
[265] Bin Cheng, "Custom: The Future of General State Practice in a Divided World" in R. St.J. Macdonald & Douglas M. Johnston, eds, The Structure and Process of International Law: Essays in Legal Philosophy Doctrine and Theory (Dordrecht: Martinus Nijhoff Publishers, 1986) 485 at 513.

juris. "[O]pinio juris is the view that is held by, or that may be said, with effect opposable to that state, to be held by, a state as to what the law is at any given moment."[266] The primary difficulty with the identification of customary international law derives from its unwritten character, with widely dispersed and sometimes inconsistent evidence.[267]

For the purposes of customary international law under sub-paragraph (b) of Article 38 of the ICJ Statute, acceptance by a generality of States is sufficient to form customary international law; acceptance by all States is not required.[268] In an area where few States have had the capability to demonstrate a consistent practice, the practice of those prevalent States able to demonstrate such practice is sufficient to form the basis of a rule of customary law.[269] "As regards the question who constitutes the prevalent or dominant section of any society, it may be said that this consists basically of those who have the intention of making their will prevail and the ability to do so."[270] According to Bin Cheng, a highly qualified publicist who has been cited a number of times in several ICJ cases,[271] "what is critical is whether it has been accepted by those among the states concerned which have both the ability and the will to uphold it, whenever the rule is, to their detriment, not being observed."[272] Therefore, the major space-faring nations are the ones in a position to affirm rules of customary international space law.

[266] *Ibid* at 548.
[267] Alan Boyle & Christine Chinkin, The Making of International Law (Oxford: Oxford University Press 2007) at 163.
[268] Cheng, Custom, *supra* note 265 at 549.
[269] Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, [1996] ICJ Rep 226; Vaughan Lowe, International Law (Oxford: Oxford University Press, 2007) at 83.
[270] Cheng, Custom, *supra* note 265 at 545.
[271] Michael Peil, "Scholarly Writings as a Source of Law: A Survey of the Use of Doctrine by the International Court of Justice," (2012) 36:1 Cambridge J Int'l & Comp Law 136 at 160.
[272] Cheng, Custom, *supra* note 265 at 547.

In a field as relatively young as space law, how does customary international law come into being? The International Court of Justice has recognized that a treaty provision can accurately reflect customary international law under two circumstances: when it codifies existing customary international law, or when such provision crystalizes emerging customary law.[273] Many of the provisions of the Outer Space Treaty satisfy these requirements. The Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space created binding norms, which were subsequently enumerated and elaborated in the Outer Space Treaty.[274] This demonstrates that the adoption of a soft law instrument can be the first step towards the development of a binding legal regime.[275] It is worth noting that in order to create legally binding rules, the phrasing needs to be "of a fundamentally norm-creating character such as could be regarded as forming the basis of a general rule of law."[276] Thus, language that is solely aspirational without a rule that can be implemented effectively in national practice will have a different character than those norms that have clear impact on the activities of States. Through direct consent provided by States in the passing of this Resolution, which acted as the predecessor to the Outer Space Treaty, along with the to-

[273] North Sea Continental Shelf Cases (1969) ICJ Reports 3 at 25; Lowe, *supra* note 269 at 83; Military and Paramilitary Activities in and against Nicaragua (Nicaragua v. United States of America), [1986] ICJ Rep 14.
[274] Manfred Lachs, The Law of Outer Space (Leiden: Sijthoff, 1972) at 138; Bin Cheng "United Nations Resolutions on Outer Space: 'Instant' Customary Law?" (1965) 5 Indian J Int'l L 23; Ivan A. Vlasic, A Space Treaty: A Preliminary Evaluation, (1967) 55 Cal L Rev 507 at 508-09; S. Vladlen Vereshchetin & Gennady M. Danilenko, "Custom as a Source of International Law of Outer Space" (1985) 13 J Space L 22 at 33, Ram Jakhu & Maria Buzdugan, "Development of the Natural Resources of the Moon and Other Celestial Bodies" (2008) 6 Astropolitics 201 at 217; Ricky J. Lee, "Reconciling International Space Law with the Commercial Realities of the Twenty-first Century" (2000) 4 Sing JICL 194 at 204.
[275] Francesco Francioni, "Beyond State Sovereignty: The Protection of Cultural Heritage as a Shared Interest of Humanity" (2004) 25 Mich J Int'l L 1209 at 1227.
[276] North Sea Continental Shelf Cases, *supra* note 273 at para 72.

tal absence of protest, space-faring States have crafted binding norms of customary international law[277] that can be applicable even in the absence of treaty ratification.

Some soft law standards, such as the UN COPUOS Space Debris Mitigation Guidelines, based on the IADC Guidelines that are discussed in greater detail Chapter 10, have begun to play an important role both for participants in the space industry and space law more generally. "While standards are not traditionally mentioned among the sources of international law…they have become more influential in shaping state conduct in regard to international relations."[278] How do these standards and principles have this influential effect on the development of international customary space law? The answer is: by creating a circumstance where it is easier to fulfill the requirements of state practice and *opinio juris*. "State practice can be expressed in a variety of ways, such as governmental actions in relation to other States, legislation, diplomatic notes, ministerial and other official statements, government manuals (as on the law of armed conflict), certain unanimous or consensus resolutions of the UN General Assembly, and increasingly, soft law instruments."[279] Though these elements all contribute to State practice, mention in a UN resolution is insufficient to establish *opinio juris* on its own, which must be established through general recognition of an obligation,[280] this is true even where resolutions have been adopted by consensus, as they were, for example, in

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[277] Lachs, Outer Space, *supra* note 274 at 138.
[278] Valentina Sara Vada, "Investing in Culture: Underwater Cultural Heritage and International Investment Law" (2009) 42 Vand J Transnat'l L 853 at 866.
[279] Anthony Aust, Handbook of International Law 2d (Cambridge, Cambridge University Press, 2010).at 6.
[280] *Ibid* at 6-7.

the case of the Remote Sensing Principles.[281] That being said, UN adoption of such resolutions/principles can spur a relatively rapid shift in existing law.[282]

In some cases, these principles also further develop the law where lacunae may have existed in the original treaty. Creating a distinction between those principles that reaffirm or interpret existing treaty language and those principles that constitute a progressive development of the *lex specialis* is difficult part of the discussion, around which there may be considerable disagreement. That being said, it is noteworthy that a more specific rule in international law is likely to prevail over a more general rule.[283]

Resolutions and guidelines are sometimes referred to as forms of *soft law* rather than *hard law* that you would find in the form of a treaty. The distinction between hard and soft law is actually not necessarily decisive in determining the extent of legal character.[284] Soft law is generally viewed as a method to focus consensus, legitimize desired conduct, and create a positive environment for consistency in the relevant State practice.[285] By these measures, hard law (treaties) can contribute to the development of customary international law before the treaty comes into force and for those States who have not ratified the treaty.

The uncertainty surrounding individual rules of customary law create a circumstance under which opportunistic claims may be made with regard to the existence or lack of existence of these norms.[286] Adding complexity to the questions is the fact that the ICJ has shifted

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[281] *The Principles Relating to Remote Sensing of the Earth from Outer Space*, UN Doc A/RES/41/65 (1986).
[282] Boyle & Chinkin, *supra* note 267 at 228.
[283] ILC Report of the Study Group on Fragmentation of International Law, A/CN4/L663/Rev1 (2004) at para 9.
[284] Boyle & Chinkin, *supra* note 267 at 210.
[285] *Ibid* at 212-215.
[286] *Ibid* at 22.

to an interpretation of the State practice requirement that, rather than a requirement of consistent State practice, there is simply a need for a lack of inconsistent State practice – often achieved by simple acquiescence[287] (with the exception of persistent objectors, further complicating the issue).

Importantly and less discussed, however, is the possibility to use UN resolutions and guidelines as a means for interpreting and applying hard law instruments, if one holds the understanding that they could be considered subsequent agreements between parties to a convention, which is discussed in more detail in the paragraph below.[288] This could potentially bring them into a more legally binding status. The relationship between the Outer Space Treaty and soft law consensus-based resolutions that specifically elaborate on standards for particular activities governed under that treaty create a solid basis for the argument that some principles in these resolutions are intended to interpret the treaty in light of new developments between the parties.

Under the VCLT, the term "subsequent agreement" between the parties is used, rather than more narrowly considered terms such as convention or treaty. While a treaty is certainly one type of agreement,[289] it is not the only type, as international agreements can take many forms with varying levels of formality and participation,[290] and may not even be in written

[287] *Ibid* at 235-236, citing North Sea Continental Shelf Cases, supra note 273 and Military and Paramilitary Activities in and Against Nicaragua, *supra* note 273 at 73.
[288] VCLT, *supra* note 110, art 31(3).
[289] *Ibid,* art 2(a).
[290] "International Agreement" Encyclopaedia Britannica, online: Britannica.com < https://www.britannica.com/topic/international-agreement>; the most basic rule of treaty interpretation under the VCLT calls for interpreting terms in accordance with their ordinary meaning, which would include a dictionary or encyclopedic definition.

form.[291] A simple "agreement" in and of itself does not require the carrying out of a domestic ratification procedure. Therefore, this author argues that where there is a clear link to an existing treaty obligation binding between the parties, such guidelines or principles can be interpreted as subsequent agreement for the purposes of treaty interpretation.[292] So, for example, if it is possible use the IADC Guidelines (discussed in greater detail in Chapter 10) to interpret Article IX of the Outer Space Treaty, then it is possible to incorporate the view that they were drafted specifically to define compliance with that arrangement. This is example is particularly helpful in light of the detailed analysis of these Guidelines in Chapter 10. In a world where agreements including these principles and guidelines are crafted with the care and negotiation that one would apply in negotiating a treaty, This author believes one would be hard pressed to argue that they do not have more legal impact than simply "recommendations." This view is admittedly controversial, but less controversial is the idea articulated above that these documents can constitute evidence of "subsequent practice in the application of the treaty" under VCLT Article 31(b), which would afford less weight than a subsequent agreement but still prove relevant to their role as international legal instruments.

With regard to subsidiary sources of international law, there are two distinct categories: *judicial decisions* and *teachings of highly qualified publicists.*[293] These subsidiary sources are used when there is not enough guidance provided by the primary sources of law, primarily to provide evidence of existing rules of law through a synthesis and analysis of state practice and other such indications of existing law.[294]

[291] VCLT, *supra* note 110, art 3.
[292] *Ibid,* art 31(3)(a)&(b).
[293] ICJ Statute, *supra* note 246, art 38(1)(d).
[294] Peil, *supra* note 271 at 141-143, 146.

In general, "the more the field is covered by decided cases the less becomes the authority of commentators and jurists."[295] The corollary, therefore, is also true: the less the field is covered by decided cases, the authority of commentators and jurists is greater.[296] Thus, where there is very little case law in the area of space, the importance of jurists' writings is more and can be further reliably utilized. Relevantly to this area of international space law, the ICJ has used the writings of such publicists for a number of purposes, including in order to demonstrate widespread State practice, interpret treaty provisions, provide context for an individual point or case, and to aid the persuasiveness of other citations.[297] Highly qualified publicists are also used in order to advocate for changes in the law, or in other words, to advance progressive development of the law.[298] It is for these stated purposes that this author utilizes publicists in this thesis as well, in addition to their value as components of a literature review.

<u>The Interrelationship Between International and National Space Law (with U.S. examples)</u>

In general, States that are host to space activities have national legislation in place to ensure their compliance with the international space law regime, particularly the Outer Space Treaty, to which there is a high level of ratification among space-faring States.[299] Under Article VI of the Outer Space Treaty, States bear responsibility for their national activities in

[295] Kronprinsessan Margareta, UK Privy Council, [1921] 1 AC 486.
[296] Virgilu Pop, Who Owns the Moon? Extraterrestrial Aspects of Land and Mineral Resources Ownership (New York: Springer, 2008) at 44.
[297] Peil, *supra* note 271 at 153-155.
[298] *Ibid* at 156.
[299] Outer Space Treaty, *supra* note 16.

space (which can include activities of both natural and corporate persons), including for compliance with the Outer Space Treaty. They are to authorize and provide continuing supervision for any such space activities. In the case of activities carried on by an international organization, responsibility falls both to the international organization and the State participants in the organization who are parties to the Treaty. This provision is the basis for national space legislation, unusually placing responsibility for private activities on States. From a business perspective, it is important to be aware of an individual State's policy in terms of promoting its space activities and/or protecting itself from responsibility and liability for such activities. This policy may impact the availability and affordability of insurance.

Likewise under Article VII of the Outer Space Treaty, each State bears liability for damage its space objects or their component parts may cause to another State (including natural and corporate persons), whether such damage is caused on the Earth, in the air, or in space. Risk management is a key feature of any business plan, arguably more so in space. The placement of liability with the launching State(s) means that States are more likely to include stringent insurance and/or other financial requirements on space actors in their national legislation (though this is not always the case; Japan, for example, is willing to absorb some liability in exchange for promoting its national space industry).[300] The Liability Convention, which creates liability regimes for space object-to-Earth/aircraft damage and space object-to-space object damage, expands upon and clarifies this provision.[301]

[300] Setsuko Aoki "Regulation of Space Activities in Japan," in Jakhu R., National Regulation of Space Activities (New York: Springer, 2010) 199 at 209.
[301] Liability Convention, *supra* note 16, art 1(c).

Because the international regime places responsibility with the State(s) with national jurisdiction for space activities,[302] individual States will promulgate and enforce their own requirements with regard to space activities. Of course, these requirements will include standards for obtaining authorization for launch and re-entry activities -- which, in the United States is handled by the Federal Aviation Administration (FAA).[303] In general, undertaking a launch includes significant elements of analysis, including risk assessment, policy review,[304] and environmental review.[305] While environmental impact assessment can determine whether or not a launch is approved, assessment of the maximum probable loss (MPL) in case of a failure will determine the levels of liability for a launch, including how much insurance (or funding, in the case of self-insurance) must be obtained in order for the launch to go forward.[306] Though this topic is discussed in greater detail in Chapter 7, it is relevant here due to the relationship with international space law.

Under this regime, the launch or reentry licensee must obtain insurance to cover claims of third parties based upon the MPL, or otherwise demonstrate financial responsibility, not to exceed the lesser of $500 million (which is periodically adjusted for inflation) or the maximum available on the world market at reasonable cost.[307] The U.S. government, subject to Congressional appropriations, may pay third-party claims in excess of the required insurance up to $1.5 billion (periodically adjusted for inflation) above the amount of the MPL-

[302] Outer Space Treaty, *supra* note 16 at art VI.
[303] Commercial Space Launch Activities Act, 51 USC §§ 50901 et seq. (2010); Aeronautics and Space, 14 CFR at chapter III, parts 415, 420, 431 & 435 (2004).
[304] *Ibid,* 431.23.
[305] National Environmental Policy Act, 42 USC § 4321.
[306] Commercial Space Launch Activities Act, 51 USC §§ 50914-50915.
[307] Insurance Requirements for Licensed or Permitted Activities 14 CFR § 440.9.

based insurance.[308] Above this level, the licensee or legally liable party will retain financial responsibility under US domestic law,[309] though responsibility is retained by the State under international law. As previously noted, insurance is the third-highest cost of a space activity (after research and development and launch costs), and thus should not be unduly laid aside as a secondary concern.

It is worth noting that while the FAA retains jurisdiction over launch and reentry activities, it does not specifically hold jurisdiction with regard to on-orbit activities; some commentators interpret this jurisdictional limitation to mean "that the risk-sharing regime would not extend to over an accident that occurred in orbit"[310] following the first thirty days. On-orbit activities are not specifically excluded in that loss must result from a "permitted or licensed activity," meaning that on-orbit activities theoretically would fall within the scope of the financial responsibility requirements.[311] However, the financial responsibility requirements are placed upon launch or reentry licensees on the basis of an MPL that would result from licensed launch or reentry activities. MPL calculations only take into consideration on-orbit risk analysis with respect to "assessing risks posted by a launch vehicle to operational satellites[.]"[312] It is unclear when an event becomes too attenuated from the launch to be con-

[308] United States Payment of Excess Third-Party Liability Claims, 14 CFR § 440.19.
[309] Liability Risk-Sharing Regime for U.S. Commercial Space Transportation: Study and Analysis, Federal Aviation Administration (April 2002), online: FAA, <https://www.faa.gov/about/office_org/headquarters_offices/ast/media/FAALiabilityRiskSharing4-02.pdf>.
[310] Matthew Kleiman, J. Lamie, M. Carminati, The Laws of Spaceflight (Chicago: American Bar Association, 2012) at 86.
[311] Determination of Maximum Probable Loss, 14 CFR § 440.7.
[312] Determination of Maximum Probable Loss, 14 CFR § 440 Appendix A.III.C.

sidered eligible for consideration under the risk-sharing regime;[313] a requirement for damage to be proximately caused by the launch or re-entry event may exist.[314] Regardless, international liability is retained by the State.

Orbital slots and radio frequencies must be registered with the International Telecommunication Union, a United Nations body with authority over those aspects of space activities.[315] Member States are bound by the ITU's Constitution, Convention, and Radio Regulations (which are deemed incorporated by reference into the treaty requirements).[316] As such, much like with regard to the Outer Space Treaty, States have a vested interest in maintaining their nationals' compliance with these international obligations.

Care must be used in determining the correct radio frequencies to use; not just from a technical and operational standpoint, but also from a legal one. For example, in the U.S., the Federal Communications Commission (FCC) regulates radio frequency usage for mobile stations within U.S. jurisdiction (which would include those that are space-based) and for any fixed or mobile stations operating within the U.S. or on a U.S. aircraft or vessel.[317] "The satellite space station licensing process is composed of three distinct processes: allocating available spectrum for the proposed satellite service, developing service rules and granting licens-

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313 Financial Responsibility Requirements for Licensed Launch Activities, Federal Register Vol 63 : No 165 (26 August 1998) at 45612.
314 *Ibid*.
315 International Telecommunication Constitution and Convention, 22 December 1992, 1825 UNTS 390, 1996 UKTS 24.
316 ITU Constitution, *supra* note 315, art 31; International Radio Regulations, 2012, online: ITU,<http://www.itu.int/pub/R-REG-RR-2012 >.
317 Title 47: Telecommunications, USC §301, see, notably, paragraph (f) which includes OST Article VIII jurisdiction over space objects; the FCC Online Table of Frequency Allocations, Telecommunication, 47 CFR § 2.106 (updated 31 August 2016), online: FCC, <http://transition.fcc.gov/oet/spectrum/table/fcctable.pdf>; Communications Satellite Act art. 201(c)(11); Communications Act titles I-III (1934); Telecommunication, 47 CFR §§ 25.130-25.139.

es to qualified applicants."[318] Once established, such usage must then be carried out without causing harmful interference to other States' equipment.[319] Additionally, the National Oceanic and Atmospheric Administration (NOAA) carries out licensing for any satellite with remote sensing capabilities.[320]

Export controls are another critical area of importance for space actors, particularly if such actors are from the United States or deal with US partners for any stage of the space activity. Compliance with U.S. export controls, known as ITARs (International Traffic in Arms Regulations) in the case of the Munitions List[321] and EARs (Export Administration Regulations) in the case of the Commerce Control List,[322] can be a costly and time-consuming endeavor. In the context of ITARs, exporting is broadly defined and includes: physically sending or taking an article beyond the borders of the U.S.; transferring control or ownership (including an on-orbit transfer); and, notably, disclosing technical data to foreign persons (whether they are located in the U.S. or elsewhere, and regardless of whether the disclosure is oral or visual).[323] Therefore, it should be apparent that a significant degree of care is required to remain in good standing.

Finally, space debris is a serious consideration for any space activity, both in terms of the safety of the activity and the responsibility of the actor to mitigate creation of further debris. Expendable launch stages, fragments of spacecraft, and dead satellites all contribute to the dangerous and ever-growing space debris problem. While there are no additional binding

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[318] Regulating Satellite Networks: Principles and Process, online: FCC, <http://transition.fcc.gov/connectglobe/sec8.html>.
[319] ITU Constitution, *supra* note 315, art 45.
[320] Commerce and Foreign Trade, 15 CFR § 960(B) Appendix 1.
[321] Introduction to US Export Controls, *supra* note 33.
[322] National Defense Authorization Act for Fiscal Year 2013, US Pub L 112-239.
[323] Foreign Relations, 22 CFR § 120.17.

requirements at an international level regarding the creation of space debris, there are soft law guidelines available.[324] Additionally, individual space-faring States have begun to implement their own requirements for the mitigation of space debris that must be taken into consideration for planning any future activity.

In brief

Despite some similarities with the Antarctic and high seas regimes, the context for space activities is unique. State responsibility for national actors in space creates an essential connection between national legislation and regulation of space and the international space law regime. Though different States will vary in their approach to authorization and continuing supervision, it is essential for commercial space actors to understand the basic framework in order to understand and perform appropriate due diligence regarding the areas in which they may be regulated and receive insurance coverage. The Outer Space Treaty, the ITU Constitution, and the databases of information available on the UNOOSA website provide useful stepping-off points for those interested in a greater understanding of the legal and regulatory implications of engaging in commercial space activities.

State Liability

In a risk-based society, there is less a question of who is at fault for damages, but who

[324] See, for example, the IADC Space Debris Mitigation Guidelines, online: IADC, <http://www.iadc-online.org/index.cgi?item=docs_pub>.

should bear the burden of the loss caused.[325] In this model, the source of responsibility is displaced from the individual to the society, where judging the risks inherently includes judgment about who should bear them in terms of social fairness.[326] Both risk and responsibility presume that there are decisions to be taken that influence individual outcomes.[327]

In this context, the problems of liability and risk are fundamentally bound to the extensive technological developments that our society has produced.[328] The most essential aspect of international space law with regard to space insurance is State liability for space activities. As explained by space law and international law scholar Bin Cheng, "space law, as it now exists, is not an independent legal system. It is merely a functional classification" of those rules of international and municipal law governing outer space.[329] 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."[330] Therefore, it must be noted that in the regime established by the Outer Space Treaty and Liability Convention, Launching States[331] are responsible and liable for the space activities of their nationals.[332]

Responsibility as we understand it today is a relatively modern concept; it did not come into use in the English language until the late 1700s.[333] In international law, "[r]esponsibility is the necessary corollary of a right. All rights of an international character involve international responsibility. If the obligation in question is not met, responsibility en-

[325] Ewald, *supra* note 62 at 279.
[326] *Ibid* at 279.
[327] Giddens, *supra* note 57 at 8.
[328] Ewald, *supra* note 62 at 295.
[329] Bin Cheng, Studies in International Space Law (Oxford: Clarendon Press, 1997) at 383.
[330] Rod Margo, "Some Aspects of Insuring Satellites" (1979) 1979 Ins LJ 555 at 565.
[331] Liability Convention, *supra* note 16, art I.
[332] Outer Space Treaty, *supra* note 16, arts VI & VII.
[333] Giddens, *supra* note 57 at 8.

tails the duty to make reparation."[334] The actor carrying out an activity leading to an event is linked with causality (by virtue of agency); however it is the more complex meaning of obligation or liability that is generally linked with both risk[335] and international law.

The Liability Convention is an elaboration of Article VII of the Outer Space Treaty,[336] which, in conjunction with the State responsibility requirements of Article VI, are arguably part of customary international law.[337] 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.[338] 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 ce-

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[334] Spanish Zone of Morocco Claims, Report 111 (1924) 2 UNRIAA 614 at 641.
[335] Giddens, *supra* note 57 at 8.
[336] Ram S. Jakhu, Legal Issues Relating to the Global Public Interest in Outer Space (2006) J Space L 31 at 52; Cheng, Studies *supra* note 329 at 636.
[337] Lysall & Larsen, *supra* note 248 at 71.
[338] Ricky J. Lee, "The Liability Convention and Private Space Launch Services" (2006) 31 Ann Air & Sp L 351 at 359.

> lestial 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 and non-nationals over whom they hold jurisdiction in outer space, including the authorization 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[339]

States are responsible for their internationally wrongful acts.[340] "Any violation by a State of any obligation, of whatever origin, gives rise to State responsibility."[341] In international law, the breach of treaty obligations is just such a violation.[342] 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.[343] The "failure to subject non-governmental national space activities to authorization and continuing supervision would constitute an independent and separate cause of responsibility" under Article VI of the Outer

[339] Carl Q. Christol, Space Law: Past, Present, and Future (Deventer: Kluwer Law and Taxation Publishers, 1991) at 260.
[340] Corfu Channel, *supra* note 105 at 23-34; Trail Smelter Arbitration (U.S. v. Canada), (1941) 3 RIAA 1938..
[341] Rainbow Warrior (New Zealand v France), (1990) 20 RIAAA 217 at 251; *Stockholm Declaration on the Human Environment*, UN Doc A/CONF.48/14 (1972), Principle 21.
[342] VCLT, *supra* note 110, art 26.
[343] Chorzów Factory (Germany v. Poland), (1928) PCIJ (se. A) No 17 at 47.

Space Treaty.[344] The applicable standard in this situation would be a due diligence standard.[345] Once that standard is met, responsibility is incurred in the instant of the breach itself, rather than the time when the state is deemed to have otherwise failed in preventing and halting a breach.[346]

The Corfu Channel case also established the *knew or should have known* international legal standard for liability.[347] 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: "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 remedy any damage caused, especially in the form of monetary payment."[348] Given this international regime, if the applicable domestic law requires it, service providers will be required to obtain coverage for the risks to cover all or some of a State's international liability; this mechanism causes the costs to trickle down to the service users.[349] Additionally, an absolute liability standard will be applied to damage caused by a

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344 Bin Cheng, "Article VI of the 1967 Space Treaty Revisited" (1972) 26 J Space L 7 at 13-14. [Cheng, "Article VI"]
345 *Ibid* at 15.
346 *Ibid*.
347 Corfu Channel, *supra* note 105 at 22-23.
348 Cheng, "Article VI" *supra* note 344 at 9-10.
349 Sgrosso, *supra* note 231 at 485.

space object on the surface of the Earth or to an aircraft in flight.[350] 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.[351] There has been no case decided on the basis of the international space law treaties.[352] 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 Territories, which resulted in a multi-million dollar payment by the USSR to Canada for damages.

Third-party 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, implying that the State is thus committed to assume the remainder of the unlimited liability beyond those limits.[353] Private insurance divests the State of the need to compensate losses it would otherwise cover for political or legal reasons.[354] Insurance can be taken out for an operator's "peace of mind" or in order to comply with certain national legis-

[350] Liability Convention, *supra* note 16, art II.
[351] *Ibid*, art III.
[352] Tanja Masson-Zwaan, "Liability and Insurance for Suborbital Flights" (Versailles, 2012) Proceedings of the 5th IAASS Conference 'A Safer Space for a Safer World' at 3.
[353] Piotr Manikowski, "The Columbia Space Shuttle Tragedy: Third-Party Liability Implication for the Insurance of Space Losses" (2005) 8:1 Risk Management and Insurance Review 141 at 3.
[354] Ericson et al, *supra* note 38 at 7.

lation, 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.”[355] 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.[356] 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.[357] For example, in late 2001 Munich Re (a major space insurer) announced rate increases for first-party insurance of 50% for launch insurance and 75% for on-orbit insurance.[358] In a different kind of example, the estimated total damage from the Columbia space shuttle tragedy is US$3 billion,[359] though NASA only received US$500,000 in claims for property damage.[360] Third party liability insurance is generally relatively inexpensive to acquire, particularly given that governments are sometimes included as joint insureds.[361] As can be seen from the Columbia example, it is not uncommon for most damage sustained to be “first party” damage.

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[355] Lovier Schoffski and Andre Georg Wegener, “Risk Management and Insurance Solutions for Space and Satellite Projects” (1999) 24:2 Geneva Papers on Risk and Insurance 203 at 203, *citing* P.J. Blassel, “Space Projects and the Coverage of Associated Risks” (1985) 10 The Geneva Papers on Risk and Insurance 36 at 51-83.
[356] Masson-Zwaan 2012, *supra* note 352 at 4.
[357] *Ibid* at 5.
[358] Jeff Foust, “Insurance woes may hurt space industry” (7 Nov, 2001) online: Spaceflight Now <http://spaceflightnow.com/news/n0111/07insurance/>.
[359] Manikowski, *supra* note 353 at 141.
[360] *Ibid* at 148.
[361] Masson-Zwaan 2012, *supra* note 352 at 5.

State Responsibility as Liability

With the exception of English, all official languages of the OST[362] use the same word for "responsibility" and "liability," although they are different concepts.[363] In international law, responsibility is a secondary obligation arising out of an internationally wrongful act attributable to a State.[364] On the contrary, liability under Article VII of the OST and the Liability Convention is a primary obligation arising out of the consent of Parties to be bound by the duty to pay compensation for damages.[365] Liability can also arise out of the secondary obligation to make reparations resulting from responsibility. As a result, it is conceptually possible that liability may arise not only under the Liability Convention, but also or alternatively Article VI of the OST.[366]

Nevertheless, *lex specialis derogat legi generali* or the specific law in a field trumps the more general legal regime: in regards to space activities, liability provisions in the *corpus juris spatialis* will override the general rules of liability under customary international law. Article VI of the OST created a coherent regime to address issues of responsibility in space that would both satisfy the concerns of those States who did not want to allow private actors in space and allow the participation of such actors. Therefore, in accordance with customary

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362 Outer Space Treaty, *supra* note 16, art XVII.
363 Stephen Gorove, "Liability in Space Law: An Overview" (1983) 8 Ann Air & Sp L 373 at 373-4; Cheng (Article VI), *supra* note 344 at 9-11; Lee (Launch Services) *supra* note 338 at 359.
364 Responsibility of States for Internationally Wrongful Acts, UN Doc A/RES/65/19 (2011) arts 1-2 [ASR]; International Law Commission's Articles on State Responsibility: Introduction, Text and Commentaries, James Crawford ed, (Cambridge: Cambridge University Press, 2002) at 59 [ASR Commentaries]; Lee (Launch Services), *supra* note 338 at 359.
365 Cheng (Article VI), *supra* note 344 at 11.
366 Lee (Launch Services), *supra* note 338 at 359.

international law as expressed in the Articles on Responsibility of States for Internationally Wrongful Acts, "Article VI should be considered to have the effect of imposing liability on a State for activities in outer space that may be attributed to the State."[367] Due to Article VI of the Outer Space Treaty, the space activities of private entities are attributable to the State. Though these articles do not represent a primary source of law themselves, the International Law Commission's work is the most frequently cited secondary source by the ICJ,[368] and thus holds substantial weight, in addition to the supporting customary law analysis which provides that the rule does indeed exist as a primary source.

In cases where neither the Outer Space Treaty nor the Liability Convention are applicable (due to lack of ratification of either treaty by one or more involved States), responsibility can still be allocated to the State for international damage. General international law rules regarding liability and damages will apply, which recognize the State's duty to pay reparation for an internationally wrongful act.[369] This avoids the need to rely solely on the proposition that Article VI of the Outer Space Treaty should be regarded as having crystalized into customary international law. Regardless of the customary status of the rule articulated by Article VI, in international law, States have a responsibility to compensate other States for harmful acts committed by individuals under their jurisdiction,[370] and thus would still be responsible for damages caused by individual or corporate activities (and all major space-faring States are currently party to the Outer Space Treaty.

[367] *Ibid.*
[368] Peil, *supra* note 271 at 146-147, 153.
[369] Clyde Eagleston, Measure of Damages in International Law, (1929) 39 Yale LJ 52 at 53; Factory at Chorzów *supra* note 343 at 47; Gabcikovo-Nagymaros Project, *supra* note 129 at 81.
[370] Trail Smelter, *supra* note 340 and progeny.

A paradigm of responsibility fosters the insurance industry, as it is based on the concept of compensating a victim for their losses. Likewise, a paradigm of solidarity is also heavily supported by insurance, though with a greater emphasis on compulsory insurance and compulsory compensation. Precaution, the new paradigm of the twenty-first century, is likely to also be closely tied to insurance, but will have to integrate a new set of values.[371]

Responsibility is reliant on the ability to manage causality and self-regulate one's behavior.[372] Fault is a key element of responsibility that is seldom discussed. It is a principle for organizing liability, and it should account for sanction, prevention, compensation, ethics, law, and politics. From a legal perspective, an individual can only be held responsible for what she should have known.[373] A benefit of a model of responsibility is that the law is based on reparation for damages.[374] Ultimately, the issue transforms from a question of who must bear the responsibility for an action into a question of who must take the risks in order to carry out the action.

Direct and Indirect Damages

When discussing insurance, the issue of applicable damages must be addressed. The starting point for the relevant *lex specialis* in this field comes from the Liability Convention. Damages under Article I of the Liability Convention are defined as "loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons,

[371] Ewald, *supra* note 62 at 274.
[372] *Ibid* at 275.
[373] *Ibid* at 276.
[374] *Ibid* at 278.

natural or juridical, or property of international intergovernmental organizations." This definition is further clarified under Article XII, which sets forth that compensation "be determined in accordance with international law and the principles of justice and equity, in order to provide such reparation … as will restore the … State … to the condition which would have existed if the damage had not occurred." Therefore, customary international law can be used to determine the measure of compensation under the Liability Convention.

According to analysis performed on behalf of the US government, Article VII of the Liability Convention "pertains only to physical…damage that space activities may cause to the citizens or property of a signatory State."[375] Pursuant to Article I, "damage" is defined as "loss of life, personal injury or other impairment of health; or loss of or damage to property on States or of persons, natural or juridical or property of international intergovernmental organizations."[376] According to the late Eilene Galloway, a scholar and early drafter of U.S. space legislation, the Liability Convention does not allow for recovery for other types of damage.[377] In the interpretation of Edward Finch, Article I creates a scenario where payable damages are "limited to those actually suffered by persons or property, and does not include punitive or indirect damages."[378] This author disagrees with this proposition.

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[375] Senate Comm On Foreign Relations, Treaty on Outer Space, S Exec. Rep No. 8, 90th Cong. 1st Sess. 5 (1967); Staff of Senate Comm. On Aeronautical and Space Sciences, Report on Convention on International Liability for Damage Caused by Space Objects, Analysis and Background Data, 92d Cong 2d Sess. 44 (Comm Print 1972).

[376] Liability Convention, *supra* note 16, art I.

[377] Eilene Galloway, "Which Method of Realization in Public International Law Can Be Considered Most Desirable and Having the Greatest Chances of Realization?" in Settlement of Space Law Disputes, Cologne Institute of Air & Space Law Colloquium 163 (1979).

[378] Edward R. Finch, Outer Space Liability, Past, Present and Future, (1980) 14 Int'l Law. 123 at 126.

Under Article VIII, a "State which suffers damage or whose natural or juridical persons suffer damage, may present to a launching State a claim for compensation for such damage."[379] Under the same article, States may also present claims for damage sustained in their territory (even if the damage is not caused to its own natural or juridical person) or for damage sustained by its permanent residents. In these latter two cases, however, the State may only submit the claim if the State of nationality has failed to present such a claim. While it is arguable that consequential or indirect loss does not constitute damage under the Liability Convention, a cornerstone of this argument is the fact that the drafters of the Liability Convention expressed their intent when they actually rejected a proposal to expressly include indirect damages in the scope of Article I(1).[380] According to Bin Cheng, however, the reason the drafters of the Liability Convention chose not to expressly address indirect damages is because they believed that damages should be considered in light of causation and causal link, rather than directness.[381] Based on both the drafting history and the fact that no provision excluding indirect damages were included in the Liability Convention, this author would agree with Professor Cheng that it was left open to be applied on a case-by-case or as-needed basis.

According to Carl Christol, indirect damage is "such damage, loss or injury as does not flow directly and immediately from the act, but only from some of the consequences or results of such act."[382] Nevertheless, under the rule applied by the Trail Smelter arbitra-

[379] Liability Convention, *supra* note 16, art VIII.
[380] COPUOS Legal Subcomm, Rep 3d Sess, 2nd Pt, UN Doc A/AC.105.21/Annex at 28 (Oct 23, 1964).
[381] Cheng (Studies), *supra* note 329 at 323.
[382] Christol, Space Law, *supra* note 339 at 95.

tion,[383] States would be unable to recover damages that are purely economic and too undertain or remote. As explained above, rules determining recoverable and compensable damages are established by the Liability Convention. The rule to be applied to in the case of space object-on-space object damage is one of legal fault, which can be aligned with the concept of proximate cause. Therefore, for damages to be compensable, a State must overcome the considerable factual hurdle of proving that the launching State was at fault and that the damage suffered was indeed caused by a space object of the other State.[384] Though in any given factual scenario, proving ownership of the damaging object may range from simple to impossible, proving legal fault is likely to be difficult and limit the range of claims that may be made under the Liability Convention.

Direct damages require compensation that puts the injured State and/or their persons into the position it was in prior to the injury.[385] These damages can include: loss of property use (due to the damage, property is unfit for its intended purpose) and the loss of revenue caused by an interruption in business operations.[386] On the other hand, damages that are indirect or consequential flow from a consequence of the act or omission rather than from the act or omission itself.[387] In international law, a "judge is free to award indirect damages," if it can be shown that such damages can be reasonably estimated and are proximately caused by the act or omission in question.[388] Article 31 of the Articles on Responsibility of States for

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[383] Trail Smelter, *supra* note 340 at 1931.
[384] Liability Convention, *supra* note 16, art III.
[385] Carl Q. Christol, "International Liability for Damage Caused by Space Objects" (1980) 74 Am J Int'l L 346 at 356-7.
[386] *Ibid*, at 359.
[387] *Ibid*, at 360.
[388] Eagleston, *supra* note 369 at 53.

Internationally Wrongful Acts demonstraties an obligation in international law to provide full reparation for damage caused by an act considered to be *internationally wrongful* under said articles. Under the rule applied in the Chorzów Factory case, a State would owe a duty to pay reparations that would "wipe out all the consequences of the illegal act and re-establish the situation which would, in all probability, have existed if that act had not been committed."[389] For another example, under the rule applied in the Zafiro claim, the burden of proof to demonstrate the portion of damages not appropriately attributable to the wrongful act or omission rested with the responsible State.[390] The situation in international law strengthens the perception that indirect damages may be possible to award under the Liability Convention. This is one murky area that could be clarified by the wording of the coverage offered for damages under an insurance policy, covering any damages likely to be available under the Liability Convention and international law.

Under this regime, a State can be "held responsible for all the consequences, not being too remote, of its wrongful conduct."[391] Thus, full reparation available in international law would include all of: restitution, compensation and satisfaction.[392] If restitution is impossible, compensation can be paid as an alternative.[393] According to the ICJ, "[i]t is a well-established rule of international law that an injured State is entitled to obtain compensation from the State which has committed an internationally wrongful act."[394] The purpose of compensation is to make up for the actual loss that was incurred as a result of the State's act

[389] Factory at Chorzów, *supra* note 343 at 47.
[390] The Zafiro, (UK v. US) 6 RIAA 160, 164-5 (1925).
[391] ASR Commentaries, *supra* note 364 at 230-231.
[392] ASR, *supra* note 364, art 34.
[393] *Ibid*, art 36.
[394] Gabcikovo-Nagymaros Project, *supra* note 129, at 81.

(or the act imputed to the State).[395] In order to be able to seek reparation, there is not a requirement that the State must experience material harm.[396]

In summation, a State is responsible to make reparations to another State if it breaches an international obligation.[397] In accordance with the rule applied in Factory at Chorzów, fault liability requires the establishment of three distinct elements: a legal obligation that can be imputed to a State, a breach of the legal obligation, and an apparent linkage between the act or the omission and the injury.[398] Standard rules of attribution under international law are overridden by Article VI of the Outer Space Treaty; thus, as long as it is a space activity in question, there need not be analysis of whether the act would traditionally be imputed to a State under international law rules, which would require, among other things, that the activity was carried out on behalf of the State.[399] In cases where fault based liability under Article III of the Liability Convention is in question, it is possible to call upon this principle in international law to assist in interpreting the specifications of this stated legal standard. It is worth noting, however, that the rules under general international law require that a wrongful act or omission occur, while the rules under the Liability Convention simply require fault in the case of damage caused in outer space. Therefore, there would be no need to prove that the act or omission was "wrongful" for a claim submitted under the Liability Convention.

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395 ASR Commentaries, *supra* note 364 at 245.
396 *Ibid*.
397 Corfu Channel, *supra* note 105 at 4.
398 Factory at Chorzów, *supra* note 343 at 47.
399 See, for example, ASR, *supra* note 364, arts 4-5.

Jurisdiction and Control

Under Article VIII of the Outer Space Treaty, the State of registry retains jurisdiction and control over a space object, as well as the personnel of that space object. The placement of an object in space, or its subsequent return to Earth, does not affect the ownership of such objects. If such objects or their component parts are found beyond the limits of the registering State, they are to be returned, though identifying data may be required from the State of registry. This article guarantees continuity of ownership, which is extraordinarily important for space enterprises. The Registration Convention, which mandates the creation of a national registry of space objects and communication of registration to the United Nations, where the space object will be placed on the international registry created by the Convention, makes this provision more robust.[400] Of course, the private ownership laws of the State of registry will be of paramount importance in dealing with an entity's property, and should be considered when selecting a registry State (which, by the rules of the Registration Convention, must also be a launching State – a State that either: launches or procures the launch of a space object, or from whose territory or facility such an object is launched.[401] This could create confusion in the case where a satellite was transferred to an insurer of a non-launching State.

So, what is jurisdiction, then? In the words of Sir Derek Bowett, "[j]urisdiction is a manifestation of state sovereignty. It has been defined as 'the capacity of a state under international law to prescribe or to enforce a rule of law." [402] With respect to space law, "'juris-

[400] Registration Convention, *supra* note 16.
[401] Liability Convention, *supra* note 16.
[402] D.W. Bowett, "Jurisdiction: Changing Patterns of Authority Over Activities and Resources" in R. St.J. Macdonald & Douglas M. Johnston, eds, The Structure and Process of

diction and control include the power of such State to legislate with respect to its space objects and the personnel on board thereof."[403] Jurisdiction itself can be broken down into two types of power: the power to make laws and take decisions, known as jurisfaction, and the power to implement and enforce laws, regulations and decisions, known as jurisaction.[404]

For the purposes of jurisdiction in outer space, the registration referred to in Article VIII can be considered a status of nationality.[405] This granting of such nationality may be compared to that of a State over its flag vessel on the high seas. This form of jurisdiction is *quasi-territorial* jurisdiction because it is comparable to the jurisdiction of sovereign States over their territory[406] (but cannot be traditional territorial jurisdiction due to Article II of the Outer Space Treaty, which forbids territorial appropriation). This quasi-territorial jurisdiction applies to the space object as well as all the persons and objects on board.[407] The Outer Space Treaty “protects the attribution of jurisdiction on the basis of the national registry as well as the identification of space objects as a way of securing the principle of liability and the right to retrieve such objects."[408] The assumption of responsibility and liability for space objects is predicated on an assumption of jurisdiction over such objects.[409] The jurisdiction, control, and ownership of space objects as established in Article VIII of the outer space treaty is per-

International Law: Essays in Legal Philosophy Doctrine and Theory (Dordrecht: Martinus Nijhoff Publishers, 1986) 555 at 555.
[403] Haanappel, *supra* note 245 at 24.
[404] Cheng, Studies *supra* note 329 at 622-623.
[405] E.R.C. van Bogaert, Aspects of Space Law (London: Kluwer Law and Taxation Publishers, 1986) at 115.
[406] Lotus (France v. Turkey), (1927) PCIJ (ser. A) No. 10 at 25.
[407] Cheng, Studies, *supra* note 329 at 467.
[408] Aldo Armando Cocca, “Convention on Registration of Objects Launched into Space” in Nandasiri Jasentuliyana & Roy S.K. Lee, eds, Manual on Space Law Volume I (Dobbs Ferry: Oceana Publications, 1979) 173 at 177-178.
[409] Stephen Gorove, “Criminal Jurisdiction in Outer Space” (1972) 6 Int’l L 313 at 316 [Gorove, Criminal Jurisdiction].

manent;[410] jurisdiction and control remain with the State of registry.[411] With specific regard to space traffic management, it is important to note that the registering State can require that other States and their respective actors in space abstain from impeding the supervision and operation of their space objects.[412]

Prior exercise of jurisdiction and control is an implied pre-requisite in the wording of the text in order for the State to "retain" such jurisdiction and control.[413] "There is no suggestion that a State or other entity can divest itself of obligations in relation to space objects by their abandonment. In short, authors Lyall and Larsen believe that a State cannot cease to be 'responsible for' or avoid any correlative duties by abandoning a space object.[414] Several prominent jurists have stated that they believe abandonment of a space object to be both impossible and prohibited by law,[415] and this author concurs with this assessment. Even if a space object itself could be abandoned, effectively abandoning jurisdiction and control, re-

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410 N. Jasentuliyana, "Regulation of Space Salvage Operations: Possibilities for the Future" (1994) 22 J Space L 5 at 13.
411 Report of the Scientific and Technical Subcommittee on its Forty-Ninth Session, COPUOS, UN Doc. A/AC.105/1001 (28 Feb. 2012); Ram Jakhu et al., "Space Policy, Law and Security" in Joseph Pelton & Angie Bukley, eds, The Farthest Shore: A 21st Century Guide to Space (Burlington: Apogee Books, 2009) 202; see also van Bogaert, *supra* note 405 at 135; Tucker, *supra* note 229 at 601; Stephan Hobe, "The Legal Framework for a Lunar Base Lex Lata and Lex Ferenda" in Outlook on Space Law over the Next 30 Years (Boston: Kluwer Law International, 1997) 135 at 135; Lachs, Outer Space, *supra* note 274 at 69; Lyall & Larsen, *supra* note 248 at 83; Dierdericks-Verschoor, *supra* note 250274 at 42; Gbenga Oduntan, Sovereignty and Jurisdiction in the Airspace and Outer Space (New York: Routledge, 2012) at 180. Under Article II of the Registration Convention, a launching State must register the space object on its national registry and inform the Secretary General of the United Nations of such registration.
412 Lachs, *supra* note 274 at 69.
413 Gorove, Criminal Jurisdiction, *supra* note 409 at 318.
414 Lyall & Larsen, *supra* note 248 at 84.
415 *Ibid* at 67, 84; Ram S. Jakhu, "Iridium-Cosmos Collision and its Implications for Space Operations" in Kai-Uwe Schrogl et al., eds, Yearbook on Space Policy 2008/2009 (Springer Wien, 2010) 254 at 259; H. Baker, Space Debris: Legal and Policy Implications (Leiden: Martinus Nijhoff Publishers, 1989); Jasentuliyana, *supra* note 410 at 16.

sponsibility and liability would still rest with the launching State, and would be unable to be abandoned.[416] As in-orbit liability for satellites that are no longer operating is rarely purchased,[417] a collision with a derelict satellite causing damage to one or more functional space assets could be detrimental for the launching State of the derelict object.

Jurisdiction and an inability to abandon a space object are essential elements for an understanding of the space debris problem that is impacting space traffic management today. It is impermissible for an actor from one State to interfere with a space object of another State, even if that object is a derelict satellite or piece of debris that could cause substantial damage. Thus, it is necessary for the State retaining jurisdiction over their space objects to have plans in place long before launching to mitigate the amount of debris they will create. Insurers can help to set the specific standards and enforce them.

Other Notable Provisions of the Outer Space Treaty

While less directly relevant to the discussion of insurance in space, there are several other key provisions of the Outer Space Treaty that must be understood in order to form a more complete picture of the international legal regime in which we operate.

The Outer Space Treaty addresses the nature of activities in outer space: peaceful. Weapons of mass destruction, including nuclear weapons, cannot be placed in orbit around the earth, on celestial bodies, or otherwise stationed in outer space. The placement of military installations or conduct of weapons testing or military maneuvers on celestial bodies is ex-

[416] Report of the Legal Subcommittee on its Fifty-First Session, COPUOS, UN Doc A/AC.105/1003 (2012) at 10.
[417] Ross, *supra* note 9 at 1098.

pressly prohibited (though the use of military personnel, equipment, and facilities for peaceful purposes is expressly permitted). While this article does restrict the development/testing and deployment of weapons in space, it provides for a stable, peaceful environment in which to conduct business, and clarifies the extent to which military personnel and equipment may be utilized. Military activities in space are permissible *per se*, and the predominant view is that such activities must simply be *non-aggressive*.

As discussed in Chapter 2 above, the definition of the terms astronaut and personnel of a spacecraft can be relevant when determining the applicability of rules of international law for rescue to space tourists, who will need to be insurable for that industry to thrive. Article V of the Outer Space Treaty sets forth that Astronauts are to be rendered all possible assistance in the event of an accident, distress, or emergency landing on the territory of another State and returned promptly to their spacecraft's State of registry. Astronauts are to render all possible assistance to other astronauts of other States in carrying on space activities. It is required for a State to immediately inform other States Parties to the Outer Space Treaty of any phenomena in outer space that could present a danger to astronauts. This provision is only relevant to those activities that involve human spaceflight. It is elaborated in the Return and Rescue Agreement, which sets forth requirements for dealing with astronauts and space objects of one State that wind up in the territory of another State.[418] While the term astronaut is problematically undefined in either the Outer Space Treaty and the Return and Rescue Agreement, it is likely to be construed in a way that protects human life, including the lives

[418] Return and Rescue Agreement, *supra* note 16.

of those individuals who may be more like passengers than traditional astronauts.[419] In the event that human spaceflight becomes more common, this provision helps to clarify the rights and obligations that will exist between such human participants. In addressing the aspects of this discussion that relate to space insurance, this topic is addressed in Chapter 2 of this thesis.

Under Article IX of the Outer Space Treaty, space activities are to be carried on with due regard to the corresponding interests of other States. The principle of due regard includes both environmental considerations and non-interference with other States' activities. Harmful contamination of outer space is to be avoided, as is adverse change to the Earth's environment from the introduction of extraterrestrial matter. States are required to undertake international consultations if they have reason to believe that their activities will cause "harmful interference" to another State's activities. A State believing its activities may be harmfully interfered with by another State's activities may also request such a consultation. While this provision to some degree limits the operational freedom of an entity carrying out space activities in terms of environmental considerations through the requirement for consultations if it seems likely to a State that their activities will harmfully interfere with those of another State's actor and the call for implementation of the principle of cooperation, it also attempts to protect those activities from other States' actors. It is important to note that because this provision is contained in a treaty formed between States, it does not serve to set standards of behavior for actors originating from the same State. It is for this reason that Bigelow Aerospace has requested that the FAA provide clarification on whether they will ensure that other

[419] Stephan Hobe, "Space Tourism Activities – Emerging Challenges to Air and Space Law?" (2007) 33 J Sp L 359. at 372.

national actors will not be able to interfere with their operation under the terms of a license issued for activities on the Moon.[420] Regardless, this provision has been shown to have limited teeth, given (for example) the lack of consultations conducted prior to kinetic anti-satellite weapon tests that can cause substantial debris.

Article XI of the Outer Space Treaty promotes information sharing regarding planned activities. States are to provide information to the "greatest extent feasible and practicable of the nature, conduct, locations and results" of their space activities. This provision is worth noting for those entities wishing to enter the space arena, as a reminder that space activities (along with their associated successes and failures) are highly public, and also highly scrutinized by the public. This reality can also be relevant for insurers making decisions about who and what to insure, under which circumstances and can help to alleviate concerns about transparency where insurers are acting as regulators.

Conclusion

Overall, the space law regime sets the general standards by which insurers will operate with regard to space-based assets and personal liability for individual spaceflight participants, though these can be and are refined through new agreements and through State practice. Individual States will require insurance or indemnification from their launching entities and space object operators in order to protect their own liability under the international space law re-

[420] "Exclusive - The FAA: regulating business on the moon" online: Reuters, 3 February 2015 <http://www.reuters.com/article/2015/02/03/us-usa-moon-business-idUSKBN0L715F20150203>.

gime, which also sets the standards for when damages may be paid, from whom, and for what types of losses.

In answering the question "from a legal and policy perspective, is there a regulatory void that needs to be filled, at least temporarily?" this chapter provides the following conclusions. First, the States directly have legal responsibility to authorize and continue to supervise their space actors. There is not, however, a specific description of how the State must accomplish these tasks. Most States undertake a licensing regime intended to satisfy the "authorization" prong of this requirement. That being said, if a State were to require insurance for the life of a space activity/space object/space project (in the existing regime, only third party insurance is required), the State could effectively delegate its obligation to supervise those actors to private insurers. If a problem with that activity were to arise, however, the State would be considered responsible at an international level for any failure of supervision. So long as States are specific in their insurance requirements, however, there is no reason to believe that an insurer would be unable to supervise a space activity to a level that a State would, particularly if the assets of the insurer are on the line. Commercially available space situational awareness helps to close the information gap between States and private actors, though States will retain an advantage by maintaining access to the military assets that provide detailed data. We know that with regard at least to several areas of emerging technology, that even the U.S. does not believe its robust domestic space law regime is currently positioned to appropriately supervise its space activities.[421] Thus, there is a gap, and there are ways that insurers could help to fill that gap until the industry(ies) in question are mature enough to function under the weight of a comprehensive and static State regulatory regime.

[421] Holdren, *supra* note 25.

In addition to the general authorization and supervision requirement, there are a number of other gaps or areas of conflict, as well. The status of spaceflight participants with regard to rescue obligations remains legally uncertain, and could be at least partially solved through insurance. As the industry continues to develop, insurers could require their clients with appropriate capabilities to offer assistance to manned missions of other clients, under whatever cost terms they see fit. In the near term, though, insurance for the passengers traveling on these vehicles is the more immediate consideration. We are still technologically a way from developing the equivalent of the American Automobile Association (AAA) for space.

The US domestic space law regime requires waivers of spaceflight operators' liability to be signed by spaceflight participants through 2025. Therefore, second party liability insurance is not and will certainly not be required in that period, at least for US operators. Instead, the spaceflight participants themselves will be motivated to seek private insurance, as they are individuals with sufficient wealth to begin with that they can afford "early adopter" pricing of spaceflight activities. From a governance perspective, this is less optimal than a mandated insurance regime, given that required insurance will create greater consistency in the market. It is still, however, better than no incentive for insurance at all.

A significant gap where insurers could provide oversight is Article IX – due regard and environmental protection. This issue is discussed in more detail with regard specifically to the space debris issue in Chapter 10. The definitional difficulties in terms of direct or indirect damages being applicable under the Liability Convention could be bypassed by insurer agreements to cover damages in as broad a range that may be considered under the Liability Convention as the insurers deem reasonable from a technological standpoint. Insurers have the flexibility to adjust these definitions year to year in a way that would be much more difficult either for States with regard to domestic regulations or to an even greater degree in international negotiations with regard to international agreements, creating an easier means for the time being for this mode of governance to adapt and adjust to changing technologies and risk profiles.

Perhaps the best argument for insurers providing governance, however, falls under Article I of the Outer Space Treaty. Though a critically important component of the treaty, the exact meanings of "free for exploration and use" and "for the benefit and in the interests of all mankind" are unclear and are difficult to implement; in other words, they lack teeth. State governments possess national interests that perhaps disadvantage them from applying the true spirit of these provisions. Space insurers, however, are insuring actors globally, and thus lack the level of dedicated national interest that a national government would have. It is in the insurers best interest to keep space free for the exploration and use of all countries on a non-discriminatory basis, and to ensure that all mankind can benefit from it, because this promotes the widest possible customer base for the insurer and also the greatest spreading of risk, minimizing the potential harm from a single loss.

This author's findings in review and critical analysis of the relevant space law literature support the theory that insurers can act in a regulatory capacity effectively, at least as a stop-gap measure while the industry matures. There are obvious gaps in the law for which space insurers can compensate.

Chapter 5: Air or Space? The Delimitation Issue

Introduction

The Outer Space Treaty and all other international Space Law conventions are silent as to where outer space begins,[422] and there is no international legal rule otherwise, be it customary or conventional, that answers the question of where airspace ends or where outer-space begins.[423] This legal lacuna is relevant to insuring activities against second and third party losses, in order to understand which liability regime may apply to those activities. In 1972, Judge Manfred Lachs of the International Court of Justice asked the following questions: (1) where are the frontiers of outer space; and (2) given that said frontiers are not yet established, is there any real dilemma in their absence?[424] The first question became relevant in 1959 with the launch of Sputnik, and was not treated with urgency.[425] In the ensuing decades, there has been a reluctance to define the boundaries of space for fear that too miserly a limit would restrict development, use and exploration of space. Further, it was deemed desirable to wait until technology had evolved sufficiently to both demonstrate the need for a limitation, and provide a better understanding of where an appropriate limit should be set.

This issue is highly relevant to the space insurance industry moving forward. Given the vast number of "suborbital" activities that are planned, it is critical to clearly determine

[422] Outer Space Treaty, *supra* note 16; Stephen Gorove, "Interpreting Article II of the Outer Space Treaty" (1969) 37:3 Fordham L Rev 349.
[423] Ram S. Jakhu, Tommaso Sgobba, Paul Stephen Dempsey, eds, The Need for an Integrated Regulatory Regime for Aviation and Space (New York: Springer Wien, 2011) at 57.
[424] Lachs, *supra* note 274 at 53-54.
[425] *Ibid* at 53.

whether the air or space liability regimes will apply, as these regimes apply drastically different liability standards. Additionally, for insurers to govern in space, it must be clear what exactly they are governing – be it a certain spatial domain or a certain set of functional activities.

In general, issues of climate change and the global environment, questions of public safety with regard to emerging aerospace activities, military and strategic needs, and the benefits of a "predictable and consistent global regulatory regime" are all key factors pointing to a present need for demarcation,[426] and can impact the provision of insurance. "It is a trite observation that there are significant differences between the legal status of airspace and that of outer space."[427] While exclusive State sovereignty is guaranteed in airspace,[428] outer space is free for the use of all States.[429] The obvious implication is that the area of outer space above any line of demarcation could be utilized by States for a variety of both civil and military purposes that could threaten the national security of a State. These differences are discussed in more detail in the immediate preceding and subsequent chapters.

Early space activities were conducted utilizing State vehicles, which (even if such vehicles could be considered aircraft) would be exempt from regulation by the ICAO, pursuant to Article 3 of the Chicago Convention of 1944. Thus, although early space activities necessarily involved passage through airspace, ICAO did not have the competence to exert juris-

[426] Joseph N. Pelton, "Beyond the Protozone: A New Global Regulatory Regime for Air and Space" (6 June 2013) Prepared for the forum on Air and Space Law at 1-2.
[427] Oduntan, *supra* note 411 at 283.
[428] Chicago Convention, *supra* note 23, art 1.
[429] Outer Space Treaty, *supra* note 16, art 1.

diction over any such activities regardless of whether they took place in air space or outer space.[430]

Further, the uncertainty of where airspace ends and outer space begins creates a potential regulatory void in safety and navigation, which, in turn, creates a risk of collision with aircraft. Regulatory uncertainty inherently chills private sector investment and affordable insurance.

The regulation of high altitude ballooning[431] as an air or space activity has brought a renewed sense of urgency to this question. Such activities, which will take place in the 21-45 kilometer range, implicate a much lower zone of near space than traditional suborbital aerospace activities, and thus could potentially set a lower bound for the conduct of space activities. It is only appropriate that balloons be a spurring force with regard to deciding questions of Space Law, as they were integral to the early formation of law regarding air space.[432]

This chapter looks at a particular, identified gap in the space law regime, namely the lack of a boundary between air and space law, that satisfies research question one as a regulatory void. A comparative and doctrinal analysis is employed to uncover the extent of the problems raised as a result of this gap. This chapter sets the stage for subsequent analysis under question three, namely, how insurance companies can act to improve the functioning of this area of space governance. This particular void, unfortunately, is not one that is optimal for insurer-led governance. Though it is possible that insurers may insure certain activities more in line with the activities of the air or space regime, a governmental decision to assign a

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[430] Jakhu et al, *supra* note 423 at 59.
[431] "History" online: WVE, <http://worldviewexperience.com/history/>.
[432] Lyall & Larsen, *supra* note 248 at 156-157.

regime would inherently the change the nature of an activity's insurance and insurability at the stroke of a pen.

The Evolution of the Boundary Question

As a society, we govern our activities through definitions and categorization of activities and physical spaces. "The legal instinct to delimit and demarcate is so strong that to ignore its imperative nature will be to completely disregard the impetus for much of the occurrence of international behavior as practiced within the overarching scope of sovereignty and jurisdiction."[433] Unfortunately, contrary to popular belief, there is no scientific or technical approach that justifies the creation of a boundary based on characteristics of the atmosphere;[434] the "notion of a 'boundary' is simply a humanly conceived constraint."[435] Thus, we must look for rationale elsewhere to the determination of such a boundary.

"[B]etween 1957 and 1960 alone the proposals made ranged from 20 to 1,500,000 kilometers."[436] An overview of approaches to the delimitation question can be found in two COPUOS documents dating back to the 1970s.[437] There have been two primary schools of thought with regard to this issue: (1) the functionalist approach, which maintains that the na-

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433 Oduntan, *supra* note 411 at 19.
434 S. Neil Hosenball & Jefferson S. Hofgard, "Delimitation of Air Space and Outer Space: Is a Boundary Needed Now?" (1986) 57 U Colorado L Rev 885 at 889.
435 TJF Pavlasek & Shantnu R Mishra, "On the lack of physical bases for defining a boundary between air space and outer space" (1982) 7 Ann Air & Sp L 399 at 413.
436 Oduntan, *supra* note 411 at 309.
437 The Question of the Definition and/or Delimitation of Outer Space, UN Doc A/AC.105/C.2/7 (1970), Addendum UN Doc A/AC.005/C.2/7 Add. 1.

ture of the activity rather than the location of the activity should be the determinant; and (2) the spatialist approach, which proposes setting a measurable physical boundary.[438]

The problem with functionalist approach, however, is the assumption that objective assessments can be made regarding which activities qualify as air or space activities;[439] this problem worsens as new and emerging technologies pose new ambiguities. Near space, the primary area in question, falls between approximately 20 and 100 kilometers, and is a range in which a variety of emerging activities are likely to take place.[440]

As the term “space object” is not specifically defined in any of the United Nations space treaties, except to say that such objects include their component parts, this term does not help to classify objects for the purposes of a functionalist approach.[441] Therefore, “[o]ne wonders…whether there are objects launched into outer space that are not ‘space objects’, and whether the two expressions ‘space objects’ and ‘objects launched into outer space’ are in fact coterminous.”[442]

Among the spatialist approaches, one theory is that States could exercise sovereignty over the airspace above their territories up to the point where they could maintain effective control. Most States, however, do not possess the technology, military expertise or resources

[438] Paul Stephen Dempsey, Public International Air Law (Montreal: McGill, 2008) at 741-64.
[439] Hosenball & Hofgard, *supra* note 434 at 888.
[440] Michael J. Strauss, “Boundaries in the Sky and a Theory of Three-Dimensional States” (2013) 28:3 J Borderlands Stud 369 at 371.
[441] Outer Space Treaty, *supra* note 16; Liability Convention, *supra* note 16; Registration Convention, *supra* note 16; Return and Rescue Agreement *supra* note 16; Moon Agreement, *supra* note 16; Cheng, Studies *supra* note 329 at 464.
[442] *Ibid* at 493.

to exercise any control over their air space, or even to detect intrusions into the area they would seek to control.[443]

The aerodynamic lift theory would hold that outer space should begin at the point above which a craft can no longer maintain aerodynamic lift from the reactions of the atmosphere upon its surfaces. As foreseeable civil aviation operations are not expected to exceed 100-130 kilometers, it has been proposed that the boundary be established in that range.[444] It is significant to note, however, that beyond the von Karman line, at 100 kilometers, "a vehicle would have to fly faster than orbital velocity in order to derive sufficient aerodynamic lift from the atmosphere to stay aloft"[445] because there is insufficient atmosphere at that altitude. This 100-kilometer line has been a widely discussed potential boundary. Unfortunately, this type of delimitation is subject to change based on the development of new technology.

The lowest point of orbital flight theory rests on the principle that the boundary should be demarcated such that space begins at the lowest possible satellite perigee, which has been suggested variously to fall between 70 and 160 kilometers.[446] Likewise, this can change with technology.

The customary practice of States is that the area where artificial satellites orbit denotes outer space, and thus outer space extends down to at least the lowest perigee of such satellites; however, this does not create any assumptions regarding the end of airspace.[447] The

[443] Oduntan, *supra* note 411 at 310.
[444] Report of the Legal Subcommittee on its forty-ninth session, held in Vienna from 22 March to 1 April 2010, COPUOS, UN Doc A/AC.105/942 at 29.
[445] "Schneider Walks the Walk," online: NASA, <http://www.nasa.gov/centers/dryden/news/X-Press/stories/2005/102105_Schneider.html>.
[446] Oduntan, *supra* note 411 at 306.
[447] Jinyuan Su, "The Delimitation Between Airspace and Outer Space and the Emergence of Aerospace Objects" (2013) 78 J Air L & Comm 355 at 360.

lowest altititude for a satellite in a circular orbit with propulsion is about 150km; a satellite in an elliptical orbit can maintain its orbit with a perigee as low as approximately 129km.[448] This practice would seem to imply, however, that outer space begins at an altitude as low as between 70 and 160 kilometers.

Fundamentally, "[s]cientific considerations are merely necessary to arrive at a suitable legal demarcation which would have a concrete and sensible basis, and around which the consensus of states can be built."[449] Unfortunately, to date, COPUOS has been unable to reach consensus on the boundary issue.[450] Some States have been reluctant to adopt a clear boundary out of concern for limiting their freedom of action.[451]

Emerging Space Activities

In 1972, Judge Lachs wrote, "delimitation would offer clear advantages. It would prevent the misunderstanding or even friction to which uncertainty tends to give rise, facilitate international cooperation."[452] In the ensuing decades, the emergence of new technologies and space activities have increased the potential for such misunderstanding and friction, as well as the creation of a patchwork system based on national regulations that creates uncertainty and ambiguity, and therefore chills growth of commercial space activities and the ability to issue insurance for such activities. These emerging activities include the develop-

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448 "Space Environment and Orbital Mechanics" online: Federation of American Scientists, <http://fas.org/spp/military/docops/army/ref_text/chap5im.htm> at 5-1 & 5-2.
449 Oduntan, *supra* note 411 at 284.
450 Jakhu et al, *supra* note 423 at 54.
451 Brian C. Weeden & Tiffany Chow, "Taking a common-pool resources approach to space sustainability: A framework and potential policies" (2012) 28 Space Pol'y 166 at 168.
452 Lachs, Outer Space, *supra* note 274 at 55.

ment of high altitude platforms, space tourism, supersonic and hypersonic transportation, military and strategic applications, dark sky stations for a variety of activities, and trans-oceanic robotic transport.[453]

Suborbital activities (discussed in more detail in Chapter 9), such as those proposed by Virgin Galactic, Blue Origin, and Swiss Space Systems, among many others, is one significant area of uncertainty. The key difference between orbital and suborbital space travel is that orbital velocity is not achieved during suborbital spaceflights, which typically climb to an altitude of about 100km.[454] To achieve orbital spaceflight, the craft must achieve a velocity that enables it to follow a path consistent with the curvature of the Earth, thus preventing the craft from being pulled back to Earth as a result of the Earth's gravitational force.[455]

It is arguable that suborbital flights, in addition to orbital flights, would fall within the purview of space law,[456] at least for responsibility and liability purposes. Under the functionalist approach, when a craft is considered to be a space object, space law would presumably apply to it for the entire duration of its journey; likewise, it is possible that Air Law would be deemed applicable to an object designated as an aircraft, regardless of its location,[457] so long as it meets the criteria specified in the definition of aircraft in the Annexes to the Chicago Convention. Aerospace objects, which 'travel through airspace and outer space seamlessly, are generally over 7,000 kilometers away from their landing strips when they descend to a 96 kilometer altitude; thus aerospace objects would be likely to traverse the airspace of another

[453] Pelton, Protozone, *supra* note 426 at 6.
[454] Tanja Masson-Zwaan & Stephen Freeland, "Between Heaven and Earth: The Legal Challenges of Human Space Travel" (2010) 66 Acta Astronautica 1597 at 1599.
[455] *Ibid* at 1599.
[456] Jakhu et al, *supra* note 423 at 57.
[457] *Ibid* at 58.

State if the boundary were indeed to be set around the 100 kilometer point.[458] While classifying suborbital and certain other non-orbital flights as aviation may seem appealing, it is worth noting, for instance, that the X-15 rocket plane can reach altitudes above 100 kilometers,[459] with officially documented flights reaching above 107km using record-breaking mach 6.7 speeds,[460] further confusing the situation. The advent of point-to-point suborbital travel will remove suborbital flight from what is arguably solely a domestic arena and bring it onto the international stage, where a line of demarcation would serve to provide significant assistance in classifying such activity.

Near Space Vehicles which can remain above a stationary point on the Earth's surface and conduct activities in outer space are divided into free-floating balloons, steered free-floaters, and maneuvering vehicles.[461] Such vehicles have distinct military implications, including "command, control, communications, intelligence, surveillance, reconnaissance (C3ISR), boost phase and terminal phase interception of missiles, and even prompt global strike missions."[462] As these craft are "based on flight theories distinct from purely aerodynamics and astrodynamics"[463] it is difficult to characterize them as clearly falling either within the purview of air law or space law. These vehicles could revolutionize access to the most relevant areas of outer space to study climate change and formulate mitigation strategies, and

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[458] Su, *supra* note 447 at 91.
[459] Hosenball & Hofgard, *supra* note 434 at 890.
[460] "NASA Armstrong Fact Sheet" (28 February 2014) online: NASA, <http://www.nasa.gov/centers/armstrong/news/FactSheets/FS-052-DFRC.html>.
[461] Su, *supra* note 447 at 90-91.
[462] *Ibid* at 91.
[463] *Ibid*.

thus encouraging their development and use should be a priority.[464] A clear boundary between air space and outer space will no doubt facilitate the development of such vehicles.

As mentioned above, balloon systems are a particular area of interest, and are being pursued by both commercial and State actors. NASA's ultra-long duration balloon has been tested to an altitude of 41.5 kilometers.[465] World View Enterprises is scheduled to begin commercial "space flights" utilizing their balloon that ascends only to around 30 kilometers.[466] For the purposes of safety and regulation, the FAA is treating this as a space activity, despite its low altitude.[467] While there may be sound regulatory and practical – market-driven – reasons for this decision, it could have significant implications on the delimitation of outer space.

Additionally, Tethered Satellite Systems, such as the Italian system utilized with the former U.S. Space Shuttle program, can be used to lower and drag satellites for temporary use with an orbital vehicle. In 1986, it was predicted that such systems could be lowered up to 100 kilometers and used at altitudes as low as 90 kilometers.[468] Were a space activity to span 100 kilometers of elevation, the question would arise as to how to address the portion of the system that might fall below a potential demarcation line.

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464 *Ibid* at 92.

465 Dean N. Reinhardt, "The Vertical Limit of State Sovereignty" (2007) 72 Journal of Air Law and Commerce 65 at 95; *citing*: "Giant NASA Balloon Lifts Off from Esrange Space Center" online: spacemart, <http://www.spacemart.com/reports/GiantNASABalloonLiftsOfFromEsrangeSpaceCenter.html>.

466 "World View Enterprises near-space balloon flights to begin in 2016" online: WVE, <http://www.gizmag.com/space-tourism-balloon-world-view/29510/>.

467 FAA Announcement, online: WVE, <http://www.worldviewexperience.com/FAA-Announcement.pdf>.

468 Hosenball & Hofgard, *supra* note 447 at 890.

Implications for International Space Law

Freedom of Access and Use, and Non-discrimination

Under the Outer Space Treaty, all States have an equal right to freely access, use and explore outer space.[469] Likewise, appropriation of any portion of outer space is impermissible.[470] Thus, the exercise of sovereignty is not permitted in outer space. "By denying sovereignty in space, the major powers sought to diffuse potential conflict."[471]

Article I of the Outer Space Treaty also establishes the principle of non-discrimination in stating that space activities "shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development." Many of the States that have publicly stated a need to work toward delimitation are developing nation that wish to establish the boundary for the purpose of ensuring their right of equal access to outer space in accordance with this provision.[472] With regard to the establishment of a boundary, a limitation test relying on effective control would deprive less technologically advanced States of their rights to use and explore outer space,[473] in contravention of the Outer Space Treaty's non-discrimination clause.[474]

Should high altitude ballooning be considered a space activity, the area in which such craft would fly would thus be likely considered as outer space rather than airspace. In that

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[469] Outer Space Treaty, *supra* note 16, art I.
[470] Outer Space Treaty, *supra* note 16, art II.
[471] Jakhu et al, *supra* note 423 at 54.
[472] These include the Czech Republic, Bangladesh, Serbia, Thailand, Tunisia, Azerbaijan, Qatar, Belarus, Brazil, Jordan, Nicaragua, Nigeria, Ukraine, and Venezuela. Oduntan, *supra* note 411at 290-291.
[473] Lachs, Outer Space, *supra* note 274 at 54.
[474] Outer Space Treaty, *supra* note 16, art I.

case, there would be significant national security implications given the imputed freedom of use that would then apply at altitudes as low as 21 kilometers. Likewise, as this technology is considerably more inexpensive and better established than many other near space activities, there are more States that would be apt to undertake such initiatives, and would be entitled to the same rights of overflight under the non-discrimination principle as enjoyed by those long-established spacefaring States. The maintenance of this non-discrimination principle is beneficial to the commercial space industry, in that it will enable the participation in this industry by entities in a greater number of countries; it would promote the development of robust space regulation, permitting regulatory forum shopping as well as launch site shopping, allowing for the minimizing of risks and reduced insurance costs.

Whether or not overflight is possible has an impact on the affordability of space activities generally in terms of mission planning. Additionally, it could impact the provision of space insurance in several ways. Firstly, overflight of other States' territories raises consideration of the relevant regulations in those territories, which potentially expands complexity and the cost of insurance. Secondly, on the other hand, the ability to overfly at lower altitudes would allow entities to choose flight paths with the lowest possible maximum probable loss, rather than selecting instead for the flight path least likely to infringe another State's airspace. Finally, regulatory insurance as discussed in Chapter 10 would be implicated from the perspective of any fines that may be imposed by a national government for violating the requirement to remain in their airspace, which may be implemented pursuant to a rule of international law.

Cooperation vis-à-vis Harmful Interference

Article IX of the Outer Space Treaty establishes one of the key principles of space activities: mutual cooperation. In accordance with this provision, States are required to carry on their space activities with due regard for the activities of other States, and are required to conduct international consultations if they believe that their activities may harmfully interfere with the activities of another State. This principle should be taken into consideration in the determination of a boundary line, as this principle will be applicable above any such line and will impact the rights and responsibilities of States in carrying on relevant activities. This is particularly relevant for those activities taking place near the lower bound of near space. Increased occurrence of these activities would, by necessary extension, imply an increased likelihood of conflict with more traditional aircraft either during the launch or return process, or in case of any malfunction that could take place during their operation at full altitude. Additionally, confusion could be created as traditional aircraft may become able to reach high altitudes akin to those used by high altitude balloons. If such balloons were deemed to be operating in airspace, likewise would such aircraft. The probability of “harmful interference” would significantly increase, and the level of international cooperation required to safely maintain space activities with due regard for other States would become more burdensome. Again, there is a twofold impact for space insurance here. If due regard is required, then insurance may be more affordable from the perspective that interference causing damage to an activity would be less likely; however, again there could be an implication for regulatory insurance depending on what national rules for ensuring due regard for other States’ activities may be implemented.

Registration Requirements and Liability Issues

The provisions of the Outer Space Treaty establishing registration requirements and liability mechanisms, as well as the relevant subsequent treaties, would also apply to any activities occurring above the line of demarcation.[475] The Registration Convention requires registration only when "a space object is launched into earth orbit or beyond."[476] Because suborbital flights are not intended to, and never actually enter Earth orbit, they are, strictly speaking, exempt from registration requirements.[477] Likewise, high altitude balloons such as those proposed by World View Enterprises[478] would be exempt as well. If their activities are classified as space activities, this could cause a gap in the existing Space Law treaty regime whereby a significant proportion of space objects would be exempt from an international registration requirement. As the retention of jurisdiction and control of a space object are, by international law, directly tied to the object's entry on a national registry, this registration gap also potentially creates a significant lacuna with regard to the basis upon which a State may exercise jurisdiction and control over such objects,[479] which obviously has implications for an insurer providing insurance to an entity undertaking such activities.

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[475] Outer Space Treaty, *supra* note 16, arts VII & VIII; Liability Convention, *supra* note 16; Registration Convention, *supra* note 16.
[476] *Ibid*, art II.
[477] M. Gerhard, "Space Tourism – The Authorization of Suborbital Space Transportation" in Frans G. von der Dunk, ed, National Space Legislation in Europe (Leiden: Martinus Nijhoff Publishers, 2011) 263 at 290.
[478] Voyage, online: WVE, <http://worldviewexperience.com/voyage/>.
[479] Outer Space Treaty, *supra* note 16, art 8.

It has been recognized in COPUOS that the boundary question is of "paramount importance" with respect to liability for space activities in particular.[480] As we have seen, there is absolute liability for damage caused by a space object on the surface of the Earth or to an aircraft in flight.[481] According to some authors, "[t]he distinction made in the Liability Convention between absolute liability for damage to the surface of the Earth or to aircraft in flight (Art. II) and fault-based liability for damage elsewhere (Art. III) implies a physical boundary."[482] Alternatively, it is possible that the Liability Convention implicates a more functionalist approach given the references to damage caused by a space object "to an aircraft in flight" and "damage being caused elsewhere than on the surface of the earth."[483]

For suborbital and other near space activities, most of such an object's journey will occur in airspace. For such activities, the likelihood that damage would be caused to an aircraft in flight or on the surface is much higher than the likelihood of damage to another space object. To foster the development of these industries, it is necessary to consider the impact that the line of demarcation will have on liability. It may be preferable to bring these activities within the well-established regime of aviation liability law,[484] though it would be necessary to consider whether such a decision would have implications with regard to the applicability of ICAO regulations, or whether it would simply subject suborbital activities to the relevant private law regime.

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[480] Report of the Legal Subcommittee, *supra* note 444 at 12.
[481] Liability Convention, *supra* note 16, art 2.
[482] Lyall & Larsen, *supra* note 248 at 171; see Dempsey, *supra* note 17 at 333-69.
[483] Liability Convention, *supra* note 16, arts 2-3.
[484] See Paul Stephen Dempsey, Aviation Liability Law (2nd ed. Lexis/Nexus 2013).

Implications for International Air Law

The right of innocent passage (over flight) through airspace for space objects, as discussed above, cannot be presumed.[485] The ICJ has held that "the principle of respect for territorial sovereignty is also directly infringed by the unauthorized over flight of a State's territory by aircraft belonging to or under the control of the government of another State."[486] Likewise, the ICJ has also specifically recognized that "a boundary represents the line of separation between areas of State sovereignty, not only on the Earth's surface but also…in the subjacent column of air."[487]

"Should suborbital vehicles be considered (primarily) as aircraft, when engaged in international air navigation, consequences would follow under the Chicago Convention [and its Annexes], mainly in terms of registration, airworthiness certification, pilot licensing and operational requirements (unless they are otherwise classified as State aircraft under Article 3 of the Convention)."[488] It is conceivable that the application of licensing requirements, safety requirements, noise and emissions requirements, and other relevant regulations would comprise a significant burden on a fledgling industry, which is part of why insurance is so important.

Of course, another difficulty with the application of ICAO's regulations is the inapplicability to State aircraft, (such as those used in military, customs and police services) under the Chicago Convention.[489] Many States still primarily use State craft to conduct space

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[485] ICAO Doc C-WP/8158 of 15/1/86; Lachs, Outer Space, *supra* note 274 at 57.
[486] Military and Paramilitary Activities in and Against Nicaragua, *supra* note 273 at 128.
[487] Frontier Dispute (Benin v. Niger) 2005 ICJ 90, 142 (July 12).
[488] Ruwantissa Abeyratne, Air Navigation Law (Heidelberg: Springer, 2012) at 231.
[489] Chicago Convention, *supra* note 23, art 3.

activities (e.g., the Russian Soyuz), and this may create a disadvantage for States such as the United States, which have begun to utilize commercial craft for government contracts. If not governed by a regulatory regime, these State craft could theoretically pose a danger to private creating a higher likelihood of an insurance payout. Depending on whether or not a State waives sovereign immunity, however, subrogation may largely mitigate this problem.

Implications for National Space Laws and Compliance with International Law

The United States

The private space sector in the U.S. has been perceived as integral to the use of space in terms of economic viability as well as international prestige and competitiveness, to the extent that NASA has been required to utilize commercial services where possible,[490] which require private insurance. With regard to suborbital flights, the U.S. has labeled this form of transportation as a space activity, rather than an aviation activity,[491] though it is regulated by the FAA. As an example, the 2004 launch of SpaceShipOne "was considered a space launch and treated as such."[492] The U.S. defines a suborbital trajectory as follows: "the intentional flight path of a launch vehicle, re-entry vehicle, or any portion thereof, whose vacuum instantaneous impact point does not leave the surface of the Earth."[493] In accordance with this def-

[490] National Aeronautics and Space Program, 51 USC § 20102 (2010); Paul Stephen Dempsey "The Evolution of US Space Policy" (2008) 33 Ann Air & Sp L 325 at 340.
[491] Final Rule on Experimental Permits for Reusable Suborbital Rockets, 72 Fed.Reg. 17001 (2007).
[492] Peter van Fenema, "Suborbital Flights and ICAO" (2005) 30 Air & Space Law 396 at 408.
[493] Commercial Space Launch Activities Act, 51 U.S.C. § 50902 (20) (2010).

inition, a vehicle would be considered to an orbital vehicle if, when allowed to continue on its launch trajectory, it would not strike the surface of the Earth. Moreover, in consideration of the demarcation issue with regard to suborbital flights, "the U.S. DOT [Department of Transportation] awards commercial astronaut wings to pilots and flight crew on board a licensed launch vehicle on a flight that exceeds 80.45 kilometers as a recognition for having reached outer space."[494]

The U.S. definition of aircraft is sufficiently broad that it could include rockets and other high altitude vehicles.[495] Based on statements by U.S. personnel, the U.S. believes that international Air Law will apply to activities that take place in near space.[496] Thus, the U.S. seems to be drawing a distinction between national law and international law: what may be a space activity under national law can qualify as aviation under international law.

No one federal agency currently holds the full competence to regulate operations of U.S. commercial space flights; it is also worth noting that aviation regulations do not take into consideration the possibility for suborbital point-to-point travel, thus even the U.S. lacks a comprehensive body of law to deal with these issues.[497] According to Henry Hertzfeld, "[w]hen (and if) suborbital markets develop, either for cargo or people, these activities of the

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[494] Michael C. Mineiro, "Assessing the Risks: Tort Liability and Risk Management in the Event of a Commercial Human Spaceflight Vehicle Accident" (2009) 74 J Air L & Comm 371 at 373.

[495] 49 USC §40102(b) (2006) defines aircraft as "any contrivance invented, used, or designed to navigate, or fly in, the air."; Reinhardt, *supra* note 465 at 87. The situation in Canada is similar. See, Canada Aeronautics Act, online: Government of Canada, <http://laws-lois.justice.gc.ca/eng/acts/A-2/>, § 3(1).

[496] Reinhardt, *supra* note 465 at 97; *citing* Michael Sirak, US Air Force Sees Promise in 'Near Space', Jane's Defense Weekly, 13 October 2004, online: SpaceData, <http://www.spacedata.net/news101304/htm> (quoting Major Elizabeth Waldrop, Chief of Space and International Law for U.S. Air Force Space Command).

[497] US Department of Transportation, Point-to-Point Commercial Space Transportation in National Aviation System: Final Report 7 (2010) at 8-9.

Federal Aviation Agency's Office of Commercial Space Transportation (FAA-AST) should be transitioned to other departments of the FAA, as the vehicles involved are closer to aircraft than to space objects from a legal regulatory perspective."[498]

Generally speaking, balloons must operate in compliance with Title 14 of the FAA Code of Federal Regulations.[499] In the case of high altitude balloons, in particular the model proposed by World View Enterprises, the FAA has issued a determination stating that this activity would fall under Chapter 509 of Title 51 of the United States Code, which applies to Commercial Space Launch Activities.[500] Thus, the provisions relevant to liability insurance and the payment of claims in excess of that insurance would apply.[501] While a collision with a domestic aircraft would be handled in accordance with U.S. domestic law, it is reasonable to assume that an international collision would be handled in accordance with the absolute liability provision of the Liability Convention. This would impose a very strict standard on this burgeoning industry.

Currently, World View Enterprises proposes utilizing Spaceport America[502] as its launch site, in accordance with its intention to be perceived as an operator of a space enterprise. It is worth noting, however, that the launch and landing of balloon-style craft requires significantly less surface area than the launch or landing of a craft designed for horizontal take off, and thus could potentially use alternative facilities or even airports for their opera-

[498] Henry R. Hertzfeld, Testimony for Hearing on the Office of Commercial Space Transportation's Fiscal Year 2012 Budget Request, House of Representatives Subcommittee on Space an Aeronautics, 5 May 2011.
[499] Balloons: Regulations & Policy, online: FAA, <http://www.faa.gov/aircraft/air_cert/design_approvals/balloons/balloons_regs/>.
[500] WVE FAA Announcement, *supra* note 467.
[501] 51 USC Ch 509 § 50914-50915.
[502] WVE FAA Announcement, *supra* note 467.

tions. This would raise additional regulatory questions with regard to appropriate facilities for, and classification of, such activities.

Fundamentally, the conflict between the FAA's attempts to categorize World View Enterprises' balloons as a space activity domestically on the basis of necessary safety requirements for the craft, while explicitly ignoring the question of whether the altitudes they will operate at qualify as "space,"[503] as well as other attempts to classify activities as space activities domestically but as aviation internationally, must be clarified. An agreed upon international boundary would go a long way to facilitate the resolution of these issues.

The European Union

The Lisbon Treaty "expressly prohibits any EU-level efforts to harmonize national regulations regarding private space activities."[504] Aviation, on the other hand, is an area of EU competence, and Member States have transferred their obligation to transpose ICAO standards through the European Aviation Safety Agency [EASA].[505] "Since sub-orbital aeroplanes are very similar to conventional aircraft in their design and operations besides the rocket-propelled and ballistic part of their flight, all basic requirements shall be fully applicable for the ground/air phase of the flight, at the exclusion of the rocket-powered and ballistic

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[503] *Ibid*.
[504] Treaty of Lisbon amending the Treaty on European Union and the Treaty establishing the European Community, 13 December 2007, OJ C 306/01, art 189; Frans G. von der Dunk, "Space Tourism, Private Spaceflight and the Law: Key Aspects" (2011) 27 Space Pol'y 146 at 149.
[505] Jean-Bruno Marciacq et al, "Accommodating Sub-Orbital Flights into the EASA Regulatory System" in Joseph N. Pelton & Ram S. Jakhu, eds, Space Safety Regulations and Standards (Oxford: Elsevier, 2010) 187 at 191.

sub-orbital phases of the flight."[506] To look to a Member State example, the German Federal Aviation Code also states that "spacecraft, rockets and similar flying objects" are deemed aircraft while traveling in airspace and thus must follow the relevant rules and regulations applicable to that designation.[507]

Australia's Line of Demarcation

In its national legislation, Australia has set the lower boundary for space activities for the purposes of national regulation to 100 kilometers.[508] In so doing, Australia was the first State to specify a clear line of demarcation for space activities. Australia has clarified, however, that this was not actually an attempt to create a definition or delimitation of outer space.[509] Interestingly, Australia's reforms of its National Airspace System define Class A airspace to possess an upper limit of 18.3 kilometers.[510] This would seem to create some uncertainty, at least for the time being, about the status of the area between 18.3 kilometers and 100 kilometers.

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506 *Ibid* at 196.
507 Jakhu et al, *supra* note 423 at 56; citing Comments of Germany in A/AC.105/635/Add.11 (26 Jan 2005) in COPUOS, Compilation of Replies Received from Member States to the Questionnaire on Possible Legal Issues with Regard to Aerospace Objects, online: UNOOSA, <http://www.unoosa.org/oosa/enSpaceLaw/aero/index.html>.
508 Australia Space Activities Act, *supra* note 203.
509 National Legislation and Practice Relating to the Definition and Delimitation of Outer Space, COPUOS UN Doc A/AC.105/865/Add.1 (20 March 2006) at 1-2.
510 Reinhardt, *supra* note 465 at 82; citing Stephen Angus, NAS Implementation Group Concept 10 (Version 5.0), online: <http://www.dotars.gov.au/airspacereform/docs/nas_concept.doc>. See also National Airspace System Implementation Group (Australia), Airspace for Everyone, Airspace Adviser No. 1.1, at 16, 18 (2003), online: <http://www.dotars.gov.au/airspacereform/docs/Airspace_for_everyone.pdf>.

Other (especially non-space faring) Nations

Despite the desire to set a demarcation line, as discussed in Section II.A., above, "non-space-faring states are in no position to exercise any pressure in the matter."[511] Regardless of this fact, many developing nations have adopted a position that there is a present need for demarcation and are actively seeking the development of a legal solution to the problem.[512] Included in these States are, for example, Azerbaijan, Bangladesh, Belarus, Brazil, the Czech Republic, Jordan, Nicaragua, Nigeria, Qatar, Serbia, Thailand, Tunisia, Ukraine and Venezuela.[513]

Domestically, some such States have set boundaries for outer space. In Belarus, for example, airspace ends and outer space begins at 20,100 meters.[514] South Africa defines outer space as "the space above the surface of the earth from a height at which it is in practice possible to operate an object in an orbit around the earth[.]"[515] The South African example conforms more closely to a more 'standard' assessment of the line, in the 100-kilometer range. Likewise, Kazakhstan has set the boundary of "cosmic space" beyond 100 kilometers

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511 Lyall & Larsen, *supra* note 248 at 162.
512 Oduntan, *supra* note 411 at 290.
513 Questions on the Definition and Delimitation of Outer Space: Replies from Member States, COPUOS UN Doc A/AC.105/889.
514 National Legislation and Practice, *supra* note 509 at 3.
515 South Africa Space Affairs Act, online: UNOOSA, <http://www.oosa.unvienna.org/oosa/en/SpaceLaw/national/south_africa/space_affairs_act_1993E.html>.

above sea level.[516] Notwithstanding the foregoing, it must be noted that if States continue the practice of unilaterally determining the location of the boundary between their respective air space and outer space, this will lead to confusion and complexity, which will be detrimental to the interests of both the aviation industry and space operations.

Political and Technical Considerations Related to the Boundary Question

> In April 2012, North Korea launched a rocket in a failed attempt to put a satellite into orbit. South Korea had threatened to shoot down the rocket if it entered South Korean Territorial airspace. But where, exactly, was that airspace? The government of South Korea was not entirely sure. Of course, it knew its airspace extended above South Korean surface territory, but how high up it extended had never been determined, either by South Korea itself or through any international agreement to establish a common limit.[517]

According to Judge Lachs, the "right of innocent passage should on principle be attributed to all States without discrimination."[518] Such right to traverse airspace over land or territorial waters does not currently exist.[519] On the occasions that such passage has occurred without permission or objection, the absence of objection has been generally attributable to the lack of knowledge of the intrusion rather than acquiescence.[520] "Reconciliation of the right of passage with the principle of [state] sovereignty [over airspace] is not impossible, as

516 "On Space Activity" The Law of the Republic of Kazakhstan dated 6 January 2012 No 528-IV online: Legal Information System of Regulatory Legal Acts of the Republic of Kazakhstan, <http://adilet.zan.kz/eng/docs/Z1200000528>, Ch 1 Art 1(6).
517 Strauss, *supra* note 440 at 369.
518 Lachs, Outer Space, *supra* note 274 at 57.
519 Jakhu et al, *supra* note 423 at 55.
520 *Ibid* at 56.

demonstrated by the right of innocent passage through territorial waters", though no such right exists in Space Law.[521]

While States have the right to exclude others from their airspace and regulate said airspace accordingly, outer space is a common-pool resource (CPR). "Defining the boundaries of the CPR is an essential first step" to the effective governance of such a resource; clearly defined boundaries have been present in other cases where CPRs have been successfully managed.[522] The issues in question with regard to regulating this CPR include not only freedom of use and rights of innocent passage, but also less obvious issues such as space traffic management, "frequency management, and consideration of stratospheric pollution"[523] including not only issues of space debris, but also such dangers as radiation, ultraviolet damage, and climate change.[524] These issues all impact the safety of using and traversing this CPR, which can have a significant impact on insurance premiums moving forward if the increasing dangers are not addressed. These problems, which have also historically been faced with regard to airspace, can be adequately addressed in terms of jurisdiction without reference to sovereignty.[525]

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521 Su, *supra* note 447 at 375.
522 Weeden & Chow, *supra* note 451 at 167-168.
523 Joseph N. Pelton, A New Integrated Global Regulatory Regime for Air and Space: Regulating the Protozone [unpublished] at 1.
524 *Ibid* at 3.
525 Lyall & Larsen, *supra* note 248 at 156-157.

Conclusion: The Importance of a Solution

It is essential to note that the problems solved by setting a boundary are primarily legal and political, rather than scientific, "[i]n pursuing the search for a solution it is essential to bear in mind the purpose it is intended to serve, i.e., to secure greater effectiveness of the law."[526] It cannot be expected that science will solve this problem for us; scientists will remain undecided, perhaps indifferent, and new technological or scientific developments may cause scientists to shift their perception of the boundary.[527] One key consideration, which has indeed been a roadblock in the selection of a boundary line, is the fact that once such a line is established it will be very difficult to amend.[528] The fact that the boundary-setting is not scientific makes it a less suitable area for technocratic insurers to regulate.

"[I]mpressive progress and final delimitation has been achieved in many zones of international importance including international land boundaries, maritime zones and in the law of the seas."[529] It is important to note that the clarity provided by an established line of demarcation would promote the commercial development of space through increased regulatory certainty and improve the insurance industry's ability to measure risk, while a failure to decide resulting in ambiguity and the absence of uniformity will hinder investment in and insurance of new activities in the space sector.[530] "[I]t is fairly common for nations to fail to resolve boundary issues until they become acute, rather than with preventive foresight – by which time their complexity may have increased, making diplomacy more difficult and rais-

[526] Lachs, *supra* note 274 at 56.
[527] Oduntan, *supra* note 411 at 310.
[528] Jakhu et al, *supra* note 423 at 57.
[529] Oduntan, *supra* note 411 at 20.
[530] Jakhu et al, *supra* note 423 at 62.

ing the risk of military conflict."[531] It would be preferable to avoid allowing such issues to become acute problems to avoid escalation and difficult negotiations.

A 1979 proposal by the U.S.S.R. set out an interesting regime for delimitation of outer space. It recommended that the region above 100/110 kilometers above sea level be considered outer space and be agreed as such in a treaty, and that space objects of States "shall retain the right to fly over the territory of other States at altitudes lower than 100 (110) kilometers above sea level for the purpose of reaching orbit or returning to earth in the territory of the launching State."[532] This proposal addresses both the considerations of the boundary itself and also a right of innocent passage as it would improve the ability for States to launch and re-enter their space objects without providing blanket permission for military intelligence and other such activities that may threaten national security. With regard to such a proposal, however, it would be beneficial to set the upper limit at which sovereignty could be asserted (ie, where a right of innocent passage could be denied); such region should include the area relevant to the use of commercial aviation, currently approximately 25-30km above sea level. Such a two-pronged proposal may be precisely what the international community needs. Ultimately, however, *caveat humana dominandi, quod omnus tangit ab omnes approbatur*; what concerns all must be approved by all.[533]

Any decision at which the international community arrives would be an improvement over no decision at all, and would improve certainty for those insurers wishing to provide coverage to the relevant industries. The above points being made, as we will see in the next

[531] Strauss, *supra* note 440 at 372.
[532] Draft Basic Provisions of the General Assembly Resolution on the Deliniation of Air Space and Outer Space and on the Legal Status of the Geostationary Satellites' Orbital Space, COPUOS UN Doc A/AC.105/L/112 (1979).
[533] Oduntan, *supra* note 411 at 20, 312.

chapter, insurers have different options available in both the aviation and space markets for underwriting risks. Though the underwriting of these risks on one market or the other is not dispositive of their status, it does contribute to governance of the space industry as a whole. Though a review of the gap created by the delimitation issue is necessary to understand the possible applicable legal regimes and insurance options for near-space industries, this is one legal gap that insurers are not well-poised to fill, except insofar as the insurers (in the absence of government regulation) will decide under which line of insurance to underwrite these activities.

Chapter 6: International Air Law in the Context of Space Insurance

Introduction

As discussed in the previous chapter, 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 important advancements for mankind. It raises some unique legal, regulatory, and insurance questions however, given the lack of a specific regime, boundary or classification (see Chapter 5), and the difficulty with simply classifying these sorts of vehicles wholesale. As reiterated throughout this thesis, insurance for spaceflight activities can be very costly, and is one of the major expenses incurred. To make matters worse, it is particularly difficult to insure the first five launches of a new launch vehicle.[534]

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. Of commercially operated transportation industries, aviation is the most technologically similar to the operation of human spaceflight vehicles.[535] "To the extent that satellite insurance involves the insurance of a vehicle which passes through the airspace, it re-

[534] Foust, *supra* note 358.
[535] Mariagrazia Spada, "Human Spaceflights Will Extend Regulatory and Legal Framework Governing Civil Aviation" (2006) IEEEAC Paper#1014 at 2.

sembles – and is, in certain respects, modeled on – aircraft insurance."[536] It is therefore worth looking at and comparing the situation these vehicles might face under international air law and aviation insurance to that which has been analyzed on the space side.

"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."[537] For an airline, insurance costs are typically less than 2% of annual budget,[538] while an average launch plus one year policy on a space object would cost approximately 15% of the insured sum.[539] Aviation rates are around 0.5% of the liability limits of the policy, whereas rates are more like 10% for space coverage[540] (not taking into account the 'plus one year'). Of course, this is comparing different packages of insurance (that include insurance for second party liability to cover passengers on the aviation side, but not the space side, for example). "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."[541] The space insurance market is a particularly unbalanced market, with a few accidents resulting in significant financial consequences,[542] due to the relatively small number of launches and associated prediction difficulties.

When space insurance first became available on the market in the 1960s, the tradi-

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[536] Margo, *supra* note 330 at 556-557.
[537] Yaw Otu Mankata Nyampong, Insuring the Air Transport Industry Against Aviation War and Terrorism Risks and Allied Perils (New York: Springer, 2013) at 17.
[538] *Ibid* at 39-40.
[539] Sgrosso, *supra* note 231 at 474.
[540] Masson-Zwaan 2012, *supra* note 352 at 6.
[541] Manikowski, *supra* note 353 at 142.
[542] Sgrosso, *supra* note 231 at 479.

tional aviation market took on those risks.[543] In 1965, the first pre-launch and on-orbit insurance for a commercial satellite was issued, while the first launch insurance was provided in 1968.[544] It was a mere eight years after the first launch of any artificial satellite (Sputnik, launched by the government of the U.S.S.R.) that insurance was being provided for a satellite on a commercial basis. It is interesting to note that the first aviation insurance policy was issued in 1911, only fifty-four years earlier.[545] In the early days of space insurance,

> Insurers who were specialized in the writing of aviation risks were best qualified to understand the technical aspects of satellites and the risks associated with their operation. In addition, the manufacturers of satellites were, in several instances, also the manufacturers of aircraft, and there was frequently close contact between these manufacturers and the aviation market.[546]

Though one author states that "[i]t is clear from discussions with insurers and brokers that they see suborbital flights as spaceflight rather than aviation."[547] While this may be the case, it does not rule out the usefulness of a comparison with aviation insurance and its development for these activities, or preclude the possibility that the situation may evolve to more closely resemble the writing of aviation risks. We simply cannot exclude an understanding of the unique issues inherent in space activities.

While it is less true that satellite or major aviation manufacturers are engaged with sub-orbital and hypersonic vehicles, it is interesting to note that one of the companies engaging in this work is Virgin, which operates a large fleet of aircraft and thus procures insurance

[543] Masson-Zwaan 2012, *supra* note 352 at 5.
[544] Margo, *supra* note 330 at 556.
[545] Nyampong, *supra* note 537 at 19.
[546] Margo, *supra* note 330 at 556 fn 3.
[547] Masson-Zwaan 2012, *supra* note 352 at 6.

for that fleet. Virgin Galactic will likely be insured through the aviation market, given the large aviation account held by Virgin for their aviation fleet and the financial substantially lower premiums available for annual policies rather than the per-flight basis that is typical of the space insurance sector.[548]

Damages paid between the late '70s and early '80s on space insurance policies were over US$850 million, but the total premiums collected and retained were only US$445 million; as a result, in the period following this spike in claims, the cost of insurance rose by 20-30%.[549] Thankfully, since the 1990s, insurers have achieved a satisfactory premium to damage ratio.[550] It is plain to see, however, that the space insurance industry has been fraught with difficulty; difficulty that may or may not be specifically relevant to sub-orbital activities.

It should go without saying that "many economies have started to move steadily in the direction of globalization."[551] Given that fact, transportation needs between different States is likely to continue to increase, and the demand for faster, more efficient transportation will also rise. Sub-orbital or hypersonic point-to-point transportation could be solutions to this problem, and appropriate insurance coverage for these activities that reflects both their nature and their risk is an important component to the success of such an activity.

This chapter utilizes both doctrinal and comparative approaches, analyzing the air law legal regime and aviation market as a point for comparison to the space law legal regime and space insurance market. In so doing, this chapter contributes to answering the question of

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[548] Ana Cristina van Oijhuizen Galhego Rosa, "Aviation or space policy: New challenges for the insurance sector to private human access to space" (2013) 92 Acta Astronautica 235 at 240.
[549] Sgrosso, *supra* note 231 at 474.
[550] *Ibid* at 477.
[551] Spada, *supra* note 535 at 1.

how insurers can improve their ability to execute governance functions and what actions they can take to improve the functioning of the space insurance market, and thereby the space insurance industry.

The Importance of Insurance in this Arena

"Amateurs talk propellant, professionals talk insurance."[552]

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."[553] Therefore, it must be noted that in the regime established by the Outer Space Treaty and Liability Convention, Launching States[554] are responsible and liable for the space activities of those individuals and corporations under their jurisdiction.[555] Likewise, States are responsible for damages caused by such parties to other States and thus will have to pay reparation for such damage caused.[556]

With regard to aviation, insurance allows commercial aviation companies to carry on their business; without it, the financial guarantees required to internalize the risks inherent in such operations would be fatal to airlines. As a result, means of risk management were sought so as to enable the continuation of civil aviation operations in spite of overwhelming risk ex-

[552] Denis Bensoussan "Space tourism risks: A space insurance perspective" (2010) 66 Acta Astronautica 1633 at 1633 quoting Pete Bahn (founder of TGV Rockets).
[553] Margo, *supra* note 330 at 565.
[554] Liability Convention, *supra* note 16 art I.
[555] Outer Space Treaty, *supra* note 16, arts VI & VII.
[556] See Chapter 4, section titled "Responsibility as Liability" for further discussion of these principles.

posure.[557]

Liability in Air Law

Given that, as discussed, it is possible that suborbital and near-space activities will be considered (in some States or in the future in a more broad international capacity) as aviation activities, 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 as well.[558] 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.

The 1929 Warsaw Convention, with 152 States Parties, revolutionized liability for commercial aviation.[559] Fundamentally, the Convention instituted a reversal of the burden of proof,[560] 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 lug-

557 Nyampong, *supra* note 537 at 18.
558 Masson-Zwaan 2012, *supra* note 352 at 2.
559 Contracting Parties To The Convention For The Unification Of Certain Rules Relating To International Carriage By Air Signed At Warsaw On 12 October 1929, online: ICAO <http://www.icao.int/secretariat/legal/List%20of%20Parties/WC-HP_EN.pdf>.
560 Warsaw Convention, *supra* note 24, art 17.

gage, except insofar as willful misconduct or the equivalent thereof could be proven.[561] 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.[562] It effectively removes the liability cap for passenger death or injury, limiting liability only if the carrier can prove they have not been negligent[563] and circumscribes liability for the comparative fault of the passenger. When the industry matured, the balance was shifted in favor of the consumer.[564] "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 imposed under the Warsaw system."[565]

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.[566] Unfortunately, largely due to issues with adjusting the liability caps for inflation, the Rome Convention has only 49 parties[567] and is missing significant aviation players like the United States.[568] The General Risks

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561 *Ibid*, art 22 & 25.
562 Contracting Parties to the Convention For The Unification Of Certain Rules For International Carriage By Air Done At Montreal On 28 May 1999, online: ICAO, <http://www.icao.int/secretariat/legal/List%20of%20Parties/Mtl99_EN.pdf>.
563 Montreal Convention, *supra* note 24, art 21.
564 Masson-Zwaan, *supra* note 352 at 2.
565 *Ibid*.
566 Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface (1952) 310 UNTS 182 [Rome Convention], art 11.
567 Convention on Compensation for Damage Caused by Aircraft to Third Parties (2009) ICAO Doc 9199 [General Risks Convention], art 4.

Convention of 2009 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, only applies if the operator can prove it was not negligent. It has, however, not yet obtained a sufficient number of ratifications to enter into force.

While the Warsaw Convention does not require compulsory insurance, the Montreal Convention does.[569] 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.[570] 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.[571] 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 operator.[572] This convention also requires insurance or a guarantee of ability to cover liability, and can be required to produce proof thereof.[573] In addition to liability rules governing an industry, the safety requirements that are imposed as a baseline also impact the insurability of an activity. Therefore, the next section will review safety requirements in public in-

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[568] Contracting Parties to the Convention On Damage Caused By Foreign Aircraft To Third Parties On The Surface Signed At Rome On 7 October 1952, online: ICAO, <http://www.icao.int/secretariat/legal/List%20of%20Parties/Rome1952_EN.pdf>.
[569] Montreal Convention, *supra* note 24, art 50.
[570] Nyampong, *supra* note 537 at 59.
[571] Rome Convention, *supra* note 566, art 15(c).
[572] General Risks Convention, *supra* note 567.
[573] *Ibid* at 7(1).

ternational air law.

Safety in Air Law and the Chicago Convention

In addition to liability rules in private international law, the public international air law rules would also be applicable to any near space or suborbital activities that might be deemed aviation activities for regulatory purposes. Thus, a brief discussion of these rules is warranted here. In accordance with the Chicago Convention, ICAO promulgates safety standards for international civil aviation.[574] Article 44 of the Chicago Convention calls upon ICAO to ensure safe, regular, efficient and economical air transport.[575] Article 27 provides a commitment to collaborate to obtain uniformity in areas which will improve or facilitate air navigation.[576] "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 International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA)."[577] Though IATA regulation is not strictly part of the legal regime, as it is regulation through industry association, it is a particularly good example of regulations developed outside of a State's authority that has significant effect on an industry.

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

[574] Chicago Convention, *supra* note 23.
[575] *Ibid*, art 4.
[576] *Ibid*, art 37.
[577] Spada, *supra* note 535 at 1.

air against the earth's surface." This definition, without amendment, would inherently rule out craft that are only rocket powered and do not have any glider capabilities (because a traditional rocket-powered craft cannot derive any support from the air; any reactions against the Earth's surface are irrelevant in this analysis), but could include many if not most of the hybrid aerospace vehicles under development today. The definition includes balloons by virtue of the fact that the gases in the balloon derive support from the atmosphere, but excludes hovercraft.

It is worth noting that the term "space object" is not specifically defined in any of the relevant space conventions. The term "object launched into outer space" or "space object" is used by the Outer Space Treaty to refer to articles that may be launched into space.[578] The Outer Space Treaty uses the term "objects" most frequently, but the diversity of terminology "seems to indicate that no consideration was given to the uniformity of terminology by the UN-COPUOS."[579] The Return and Rescue Agreement uses the terms "space object" and "spacecraft" (for a space object carrying personnel).[580] The Liability Convention is, from a temporal perspective, the first of the space conventions to provide a definition of the term "space object," though the definition is self-referential. Here, the term is defined to include "component parts of a space object as well as its launch vehicle and parts thereof."[581] The Registration Convention utilizes an identical definition.[582]

[578] Outer Space Treaty, *supra* note 16, arts IV, VII, VIII & X.
[579] Imre Anthony Csabafi, The Concept of State Jurisdiction in International Space Law (Leiden: Martinus Nijhoff Publishers, 1971) at 11.
[580] Return and Rescue Agreement, *supra* note 16, arts 1-5.
[581] Liability Convention, *supra* note 16, art I(d).
[582] Registration Convention, *supra* note 16, art I(b).

To reiterate the problems regarding the shifting terminology of the Outer Space Treaty, "[o]ne wonders…whether there are objects launched into outer space that are not 'space objects', and whether the two expressions 'space objects' and 'objects launched into outer space' are in fact coterminous."[583] Given the consistency with which the term "space object" is applied in both the Liability Convention and Registration Convention, which are more recent agreements than the Outer Space Treaty, and the fact that none of the space treaties provide any insight into the differences between "objects launched into space," "space objects," or any other variant of the term, any distinction appears to be one without intent.[584] "From the legal standpoint, 'space object' is, in current practice, the generic term used to cover spacecraft, satellites, and in fact anything that human beings launch or attempt to launch into space, including their components and launch vehicles, as well as parts thereof."[585] Unlike the definition of aircraft, then, there is no technical distinction for a space object other than that it be launched into outer space, a term that is also undefined and which is discussed in further detail in Chapter 10.

While attempting to suddenly implement the strict licensing, technical, and other safety guidelines from the commercial aviation industry 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. This regime could be created at the State or (initially) insurer level.

With sufficient development and testing, it may even be possible to apply some of the

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[583] Cheng, Studies, *supra* note 329 at 493.
[584] *Ibid* at 495.
[585] *Ibid* at 463.

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 neighbouring States without necessarily violating the sovereign rights of the other State."[586] 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 pressurization and protection, g-constrained trajectories to more innovative concepts like pressure suits, helmets, internal and external airbags, ejection capsule and parachutes."[587] In general, one effective way to further develop space travel passenger services would be through substantial collaboration with the aviation industry, which would help to involve

[586] *Ibid* at 3.
[587] Bensoussan, *supra* note 552 at 1637.

their commercial viability.[588] 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."[589] 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.

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, we can discuss aviation insurance in a way that we can compare 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."[590] In fact,

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[588] Spada, supra note 535 at 3, citing P. Collins & Y. Funatsu, "Collaboration with Aviation-The Key to Commercialization of Space Activities" (2000) online: Space Future, <www.spacefuture.com>.
[589] Spada, *supra* note 535 at 6.
[590] Nyampong, *supra* note 572 at 39 (citations omitted).

even "satellite operations are considered by insurers to be of an aviation nature[.]"[591]

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 overarching purpose of insurance contract. A risk entails four possible responses from the person at risk: acceptance; elimination; reduction; and transfer."[592] 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.[593] Meanwhile, rates for passenger insurance are determined by factors such as the type of aircraft, flight duration, liability regime, and so forth.[594]

"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."[595] 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.[596]

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[591] Margo, *supra* note 330 at 565.
[592] Abeyratne, *supra* note 18, citing Rod D. Margo, "Risk Management and Insurance" (1992) 17 Ann Air & Sp L 59 at 80.
[593] Masson-Zwaan 2012, *supra* note 352 at 4.
[594] *Ibid*.
[595] Abeyratne, *supra* note 18 at 191.
[596] Schoffski and Wegener, *supra* note 355 at 205.

The Unique Challenges of Sub-Orbital Flight and Hypersonic Intercontinental Transportation

Space planes that neither fit the traditional definitions of an air or spacecraft can also create confusion as to whether or not the air law regime might apply. Types of space planes can include: supersonic space planes, hybrid aerospace systems that can function on rocket engines more like a spacecraft and on a more traditional aircraft engines, and multistage aero-space planes with aircraft that launch the space vehicles.[597] "[A]eronautics principles and air-craft 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.[598]

> 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.[599]

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, relatively high loss occurrence, and high limits reflecting potentially large losses.[600] With the small number of test flights yet achieved, the statistical risk is challenging to assess and this

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[597] Sgrosso, *supra* note 231 at 280-289.
[598] Bensoussan, *supra* note 552 at 1635.
[599] Rosa, *supra* note 548 at 235.
[600] Schoffski and Wegener, *supra* note 355 at 209.

difficulty can lead to higher premiums and lower capacity in short term.[601] 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.[602] 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 at least as good as one in two million.[603]

> 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…[604]

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.[605] 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

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601 Rosa, *supra* note 548 at 238.
602 Nyampong, *supra* note 572 at 54.
603 Bensoussan, *supra* note 552 at 1637.
604 *Ibid* at 1638.
605 Schoffski and Wegener, *supra* note 355 at 210

(which can include aviation, space, and marine).[606] 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.[607] 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, civil commotion, or radiation.[608] In terms of the lead vehicle (e.g., Virgin Galactic's WhiteKnight), would the hull risk be considered an aviation risk or a space risk?[609]

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.[610]

> Before the separation, the combined aircraft/space vehicle has the characteristics of an aircraft in terms of technical functions, flight pattern and manoeuvrability. While connected, it also derives support in the atmosphere from the reactions in 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.[611]

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

[606] Rosa, *supra* note5 48 at 236.
[607] Bensoussan, *supra* note 552 at 1635.
[608] *Ibid* at 1635.
[609] *Ibid* at 1634.
[610] *Ibid* at 1635.
[611] Rosa, *supra* note 548 at 238 citing Stephan Hobe "Future High-Altitude Flight – An Attractive Commercial Nice, Scenario 2 – Air Launch" (2007) FLACON Project Report at 4.

principles based on data from the full range of past experiences.[612] Granted, the smaller numbers available with regard to space activities is even more striking than with regard to aviation. There is a narrower range of risk coverage in the space insurance market as compared to the aviation insurance market, which would potentially be able to govern a market for suborbital space tourism given the lack of an otherwise applicable regime for this activity.[613]

Conclusion: Progressive Development of Space Insurance with Relation to the Aviation Market

There are a number of recommendations that emerge from this chapter's analysis with regard to research sub-question three ("what actions can [insurers] undertake to improve their ability to execute that governance function?"). 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. Second party liability insurance for passengers could be provided by the aviation insurance market, rather than the traditional space insurance with necessary changes to account for the differences in technology and legal regime.[614] 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. Third party liability insurance for these activities can be carried either within what are traditionally aviation or space insurance markets, given that both have relevant experience with these types of

[612] Nyampong, *supra* note 572 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.
[613] Rosa, *supra* note 548 at 240.
[614] Masson-Zwaan 2012, *supra* note 352 at 7.

risks.[615] First party liability (the hull insurance for these vehicles) will need to be developed in such a way that takes the experiences of both insurance markets into account.

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

In order to maintain reasonable user costs, an insurance premium under 1% of the value of the vehicle would need to be achieved. [616] 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. Using this model, assuming one is able to negotiate a favorable rate of 10% of the value of the insured vehicle as a cost for the insurance policy, every ten launches would cost the full value of the vehicle to insure. This type of insurance was simply not made to cover these kinds of risks and is not financially viable for them; imagine paying more than five times the value of the vehicle itself to insure it for weekly launches over the course of one year. Hull insurance will need to be provided on a model more similar to that of the aviation market in order for this industry to be financially viable. The evolution of aviation and its corresponding insurance has demonstrated that this kind of insurance can be not only possible, but also profitable.

[615] *Ibid*.

[616] Rosa, *supra* note 548 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).

The provision of insurance is important, regardless of whether we term suborbital and hypersonic flights as space, aviation, or some form of hybrid aerospace activity. Though first party insurance is not essential where entities are willing to risk their financial viability or where they have sufficient assets to self-insure, third party liability is generally required by States unless an entity can prove its liquidity to self-insure. Thus, for a majority of entities that would undertake new space activities, the availability of third party insurance is absolutely critical. With regard to both space and aviation activities, States must be sensitive to the brittleness of both the aviation and space markets and thus must create an environment that ensures the availability of insurance for these activities. [617]

Finally, the ability to leverage communication, navigation, surveillance, and decision support systems is essential to create a modernized airspace system; the integration of space and aviation operations will be key to ensuring the provision of efficient service to all users.[618] Thus, a liability and insurance regime that is supportive of this integration is essential to the safe operation of both aviation and suborbital activities. While it is up to the States, both individually and in cooperation, to provide the basis for a regulatory environment that makes space insurable; insurers can build upon this environment to minimize costs and promote space safety and sustainability.

[617] Abeyratne, *supra* note 18 at 209-210.
[618] Spada, *supra* note 535 at 2.

Chapter 7: Space Business and Insurance Issues in the United States

Introduction

The U.S. is regarded to have the most comprehensive set of laws and regulations that have been developed thus far in the space arena. This chapter will first analyze the existing regime up until November 2015, and then subsequently discuss the changes that have been created moving forward from that date. "The US Government has passed quite a substantive body of rules governing private human spaceflight, mainly designed to enable entrepreneurs to go ahead with offering suborbital flights under conditions which are less stringent than for classical transport."[619] This less stringent regime leaves regulatory gaps and does not hold these actors to as detailed or complex requirements as they would a more mature industry. Thus, this chapter asks where are the gaps that need to be filled, can insurers step into a role to fill them, and how can they do so? Each section below covers a different aspect of the U.S. legal and regulatory regime, testing for lacunae and demonstrating areas where risk may exist. Given the body of U.S. domestic space law available, this chapter focuses on a doctrinal methodological approach.

Title 51

With regard to understanding US Federal Space Law, Dr. Stephen Doyle provides a helpful brief overview of the law-making process in the US:

[619] Masson-Zwaan & Freeland, *supra* note 454 at 1600.

> Under authority granted by the Constitution, the US Congress promulgates national legislation, published, after executive approval, in the form of Public Laws, and consolidated in the US Code and in the Statutes…In its turn, Congress authorizes federal government agencies to adopt necessary rules, regulations, and policies to implement the roles and functions given to the agencies by the Constitution and by Congress. Rules and regulations of the agencies are collected and published as the Code of Federal Regulations…In addition to adoption of rules and regulations, federal agencies may adopt and implement internal agency policies to guide and manage administrative practices of agencies.[620]

The Reagan era saw emphasis on the conviction that the private sector could accomplish spaceflight more "efficiently and more appropriately" than the government, and thus the Commercial Space Launch Act was passed in 1984 to encourage commercial space launches and implement appropriate licensing requirements for such launches.[621] The private space sector in the US has been perceived as integral to the use of space in terms of economic viability as well as international prestige and competitiveness, to the extent that NASA has been required to utilize commercial services where possible.[622] In 2005 NASA initiated its Commercial Crew and Cargo Program that, in part, is intended to establish a market environment such that the space transportation services will be available to both public and private sector customers; in accordance with this objective, NASA has awarded Space Act Agreements,

[620] Stephen E.Doyle, "Astronauts and Cosmonauts in International Cooperation A View of the American Experience" in Karl-Heinz Böckstiegel, ed, Manned Spaceflight: Legal Aspects in the Light of Scientific and Technical Development (Carl Heymanns Verlag, 1993) 43 at 43-44.

[621] Joanne Irene Gabrynowicz, "One Half Century and Counting: The Evolution of US National Space Law and Three Long-Term Emerging Issues" (2010) 4:2 Harv L & Pol'y Rev 405 at 410-411.

[622] National Aeronautics and Space Program, 51 USC § 20102 (2010); Dempsey 2008, *supra* note 490 at 340.

which fundamentally are flexible contracts, to private sector entities.[623] Given the US's intent to foster the growth of the commercial space industry, there has been a wide array of legislation and regulation promulgated in this area.

The relevant federal legislation on National and Commercial Space Programs has been consolidated into Title 51 of the US Code.[624] In addition to this legislation, the executive branch issues regulations in the form of National Space Policy and Space Transportation Directives.[625]

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 for third party liability in U.S. launch law.[626] "This regime is comprised of mandatory cross-waivers of liability, insurance and financial responsibility requirements, and conditional catastrophic indemnification."[627] Liability for space activities is addressed at the national level in the U.S. through the Commercial Space Launch Act.[628] 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 $500 million. MPL calculations have been as

[623] Dennis Stone, Alan Lidenmoyer, George French, Elon Musk, David Gump, Chirinjeev Kathuria, Charles Miller, Mark Sirangelo & Tom Pickens, "NASA's Approach to Commercial Cargo and Crew Transportation" (2008) 63 Acta Astronautica 192 at 192-193.
[624] National and Commercial Space Programs, 51 USC (2010); see also Rob Sukol, "Positive Law Codification of Space Programs: The Enactment of Title 51, United States Code" (2011) 37 J Space L 1.
[625] Michael Mineiro, "Commercial Human Spaceflight in the United States: Federal Licensing and Tort Liability" (LLM Thesis, McGill University Institute of Air and Space Law, 2008) [unpublished] at 11.
[626] Gabrynowicz, *supra* note 621 at 410-412.
[627] Mineiro, "Assessing the Risks" *supra* note 494 at 392.
[628] 51 USC § 50901 et seq.

low as $3 million and as high as $268 million.[629] Congress can allocate funds to indemnify the licensee for the amount between the MPL and $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 $2 billion.[630] Coverage for natural disasters provides an interesting comparison: it includes a two-level compensation scheme where the State will provide coverage if a super-disaster occurs.[631] 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.[632] Thus, it is in the best interests of these parties to maintain first party insurance in case of a loss. According to FAA calculations, there is less than a one in ten million chance of a loss exceeding the required insurance and triggering U.S. government liability,[633] which is why there has been a call in the 2015 Commercial Space Launch Competitiveness Act to reevaluate whether the MPL requirement is excessive.

The cross-waiver of liability provisions up to November 2015 have specifically excluded spaceflight participants from having waivers with private entities, though spaceflight

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629 Schaefer, *supra* note 226 at 241.
630 51 USC §§ 50914-50915. 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 (February 4, 2014) at 3; citing GAO-12-767T, Testimony before the Science, Space, and Technology Committee, June 6, 2012 at 5, online: GAO, <http://www.gao.gov/assets/600/591391.pdf>.
631 Ewald, *supra* note 62 at 298.
632 51 USC §§ 50914-50915.
633 Schaefer, *supra* note 226 at 242 citing "An Examination of Future Commercial Launch Markets & FAA's Launch Indemnification Program: Hearing Before the Subcomm. on Space and Aeronautics of the H Comm on Sci, Space, and Tech" 112th Cong 2 (6 June 2012) online: <http://science.house.gov/sites/republicans.science.house.gov/files/documents/ hearings/HHRG-112-%20SY16-20120606-SD001.pdf> .

participants were required to waive liability with respect to the federal government.[634] The exclusion left the possibility of commercial human space flight operators suing manufacturers in order to indemnify the damages they would have to pay to spaceflight participants injured in the course of spaceflight activities.[635] Manufacturers can also be sued to indemnify damages paid to injured third parties, who by definition owe no waiver of liability.[636] Informed consent must also be acquired from spaceflight participants. The statute provides that:

> The holder of a license or a permit under this chapter may launch or reenter a spaceflight participant only if—
> (A) in accordance with regulations promulgated by the Secretary, the holder of the license or permit has informed the spaceflight participant in writing about the risks of the launch and reentry, including the safety record of the launch or reentry vehicle type, and the Secretary has informed the spaceflight participant in writing of any relevant information related to risk or probable loss during each phase of flight gathered by the Secretary in making the determination required by section 50914(a)(2) and (c);
> (B) the holder of the license or permit has informed any spaceflight participant in writing, prior to receiving any compensation from that spaceflight participant or (in the case of spaceflight participant not providing compensation) otherwise concluding any agreement to fly that spaceflight participant, that the United States Government has not certified the launch vehicle as safe for carrying crew or spaceflight participants;
> (C) in accordance with regulations promulgated by the Secretary, the spaceflight participant has provided written informed con- sent to participate in the launch and reentry and written certification of compliance with any regulations promulgated under paragraph (6)(A)…[637]

The holder of an experimental permit may not carry passengers for compensation; this type of permit may be used for research, development, testing and demonstrating compliance on-

[634] Schaefer, *supra* note 226 at 245-246.
[635] Mineiro, "Assessing the Risks," *supra* note 494 at 397
[636] Mineiro, "Assessing the Risks," *supra* note 494 at 397.
[637] Commercial Space Launch Activities Act, 51 USC § 50905 (2010).

ly.[638] It should be noted that, "rather than imposing certification, the US regime is one of non-certification, leading to an absence of contractual liability as long as the 'informed consent' requirement is complied with."[639] Generally speaking, "the developed case law on pre-recreational warnings is fairly uniform in saying that effective or legally supportable warnings are specific, obvious and direct, unambiguous, easy to understand, simple and complete."[640] Thus, such warnings and their sufficiency can be adequately addressed within the context of the US legal system.

FAA Regulations

As noted above, States bear international responsibility for their national activities in space, including both public entities and private companies, activities need to be appropriately licensed by a national government.[641] Under U.S. national space law as codified in Chapter 509 of Title 51, the Federal Aviation Administration (FAA) retains responsibility for licensing nongovernmental U.S. space activities, including launching and reentry.[642] The corresponding regulations issued pursuant to Chapter 509 can be found in 14 CFR at Chapter III, parts 415, 420, 431 and 435. A license is required of anyone seeking to conduct a launch or reentry or operate a launch/reentry site in the U.S.; a U.S. citizen (including corporations)

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[638] Commercial Space Launch Activities Act, 51 USC § 50906 (2010).
[639] von der Dunk, "Key Aspects," *supra* note 504 at 152.
[640] 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 118.
[641] John C. Mankins, Space Solar Power: The First International Assessment of Space Solar Power: Opportunities, Issues, and Potential Pathways Forward (Paris: International Academy of Astronautics, 2011) at 71.
[642] 51 USC §§ 50901 et seq.

seeking to launch or reenter a vehicle or operate a launch/reentry vehicle outside the U.S., or a U.S. citizen launching or reentering a vehicle or operating a launch site in a foreign territory if an agreement with the government of the foreign territory states that the U.S. will exercise jurisdiction.[643] It is important to note that a license is not required in the case of a consortium launching outside the territory of the State only where an agreement with a foreign country states that said country maintains jurisdiction over the launch, reentry, or facility.[644] For example, domestic laws exist in Germany and the United Kingdom allowing U.S. licensing procedures to satisfy their domestic requirements such that the launching entity will not have to undergo a duplicative procedure.

While informed consent rules (typically seen with regard to medical procedures) vary between U.S. states, all fifty have adopted legislation governing the rules that apply to the invocation of an informed consent doctrine generally (not specifically with regard to spaceflight).[645] Liability waivers, on the other hand, are a different matter (though widely used across many industries) – these waivers are enforceable in the vast majority of U.S. jurisdictions, but there are a few states in which they will not be enforced.[646]

The FAA AST (Associate Administrator for Space Transportation) will conduct an Environmental Review in order to assess the environmental impacts of a proposed activity.[647] This is a complex process involving the FAA and Environmental Protection Agency (EPA),

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643 51 USC § 50904 (a).
644 51 USC § 50904 (a)(3).
645 T. Pape, "Legal and ethical considerations of informed consent" (1997) 65:6 AORN Journal 1122-1127.
646 Michael L. Amaro, "Pre-event Waivers and Releases: A Comparative Review of Current State Laws" online: Prindle Law, <http://www.prindlelaw.com/A&P/WAIVERS%20-%20STATE%20BY%20STATE.PDF>. For more detail, see state specific section below.
647 42 USC § 4321.

as well as a public hearing and a 45-day public review period. The FAA has provided a set of Guidelines for Compliance with the National Environmental Policy Act and Related Environmental Review Statutes, which are available to help entities properly navigate the process.[648]

The FAA will conduct a policy review, following an initial consultation, which will require extensive information from the applicant, including information on the launch vehicle and systems as well as ownership information and data regarding the flight profile.[649] This review will ascertain whether there may be adverse impacts to the U.S. in terms of international obligations, national security issues, or foreign policy interests.[650] As part of a subsequent review, an applicant will be required to show that the proposed operation will satisfy the relevant risk standards.[651] An FAA-conducted payload review will establish whether the applicant has appropriately obtained any necessary licenses, authorizations, or permits, some of which will be discussed in the following section, and ensure that the launch of such a payload would not be detrimental to health and safety or U.S. policy.[652] The FAA, however, may waive its licensing requirements as it sees fit.[653] Though the FAA may not conduct a full payload review in circumstances where an FCC license has been obtained, the payload review does have the effect of extending "the scope of the Office of Commercial Space Transporta-

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648 Associate Administrator for Commercial Space Transportation, Guidelines for Compliance with the National Environmental Policy Act and Related Environmental Review Statutes for the Licensing of Commercial Launches and Launch Sites online: FAA, <https://www.faa.gov/about/office_org/headquarters_offices/ast/licenses_permits/media/EPA5DKS.pdf>.
649 14 CFR § 431.25.
650 14 CFR § 431.23
651 14 CFR § 431.35.
652 14 CFR § 415.51.
653 51 USC § 50905(b)(3); 14 CFR § 404.5(b).

tion's authorization and control beyond just the activities of launching and re-entry to include the nature, operation and activities of all space objects launched or re-entered under United States license" with in terms of safety, security and foreign policy interests, and international obligations.[654] A payload owner or operator can request a review in advance in order to receive a determination of any issue raised that could impede the issuance of a license,[655] which is exactly what Bigelow Aerospace did when contemplating the complexities of a potential future lunar base.

Though the FAA maintains jurisdiction over launch and reentry activities, it does not have jurisdiction over on-orbit or beyond orbit activities. This "means that the risk-sharing regime would not extend to over an accident that occurred in orbit."[656] Wireless energy transmission, for example, is not part of FAA responsibility, and there is no requirement to maintain insurance for such transmission.[657] Given concerns regarding the transmission of solar energy to earth stations, this gap is potentially problematic for this sort of activity (see further discussion in Chapter 8). The issue of whether FAA authority should be extended to cover on-orbit and beyond orbit operations through an amendment to the CSLA is under discussion by the Space Subcommittee of the House; Science, Space and Technology Commit-

[654] Review of Existing National Space Legislation Illustrating How States are Implementing, as Appropriate, Their Responsibilities to Authorize and Provide Continuing Supervision of Non-governmental Entities in Outer Space: Note by the Secretariat, COPUOS, 40th Sess, § 1(2), UN Doc A/AC. 105/C.2/L.224 (2001), § II(I)(68).
[655] 14 CFR § 415.56.
[656] Kleiman, *supra* note 310 at 86.
[657] Deliana Ernst, "Beam It Down, Scotty: The Regulatory Framework for Space-Based Solar Power" (2013) 22:3 Review of European, Comparative & International Environmental Law 354 at 360-361.

tee.[658] Bigelow Aerospace has requested feedback from the FAA regarding whether they could be licensed and protected for lunar activities, and the FAA has responded saying that it would be possible to issue a launch license for such an activity and that the FAA would use their launch licensing rules to protect lunar ventures as best as possible.[659]

Though they have the authority to do so,[660] the FAA has not implemented any specific medical requirements for spaceflight participants, though the FAA strongly recommends that spaceflight participants seek medical advice before engaging in more taxing orbital missions.[661] License holders must satisfy the Human Spaceflight Requirements for Crew and Spaceflight Participants in order to be allowed to carry spaceflight participants.[662] These requirements "apply to all applicants for a license or permit who propose to have a SFP on board a vehicle, all operators licensed or permitted who have a SFP on board, and all SFP engaged in an activity authorized under the Act."[663]

The FAA's launch licensing process and level of authority is important and relevant to the issues discussed in this thesis, at least as far as U.S. space activities are concerned. Firstly, entities licensed by the FAA are required to comply with statutory third party insur-

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658 Marcia S. Smith, House Hearing Reveals FAA-COMSTAC Rift on Learning Period for Commercial Human Spaceflight (Feb 4, 2014) online: Space Policy Online, <http://www.spacepolicyonline.com/news/house-hearing-reveals-faa-comstac-rift-on-learning-period-for-commercial-human-spaceflight>.
659 Leonard David, "Moon Space Law: Legal Debate Swirls Around Private Lunar Ventures" (24 February 2015) Space.com <http://www.space.com/28645-moon-space-law-lunar-legal-debate.html>.
660 Commercial Space Launch Activities Act, 51 USC § 50905 (2010).
661 Kenneth Wong, "Developing Commercial Human Space-Flight Regulations" in Joseph N. Pelton & Ram S. Jakhu (eds) Space Safety Regulations and Standards (Elsevier, 2010) 149 at 155.
662 Final Rule on Human Spaceflight Requirements for Crew and Spaceflight Participants, 71 Fed.Reg. 75616 (December 15, 2006).
663 Mineiro, "Commercial Human Spaceflight," *supra* note 625 at 51.

ance requirements. Secondly, the level of protections offered to such space companies by their State regulatory bodies will determine whether these activities are viable and thus financially sound, insurable ventures. Finally, the limits of FAA jurisdiction can help insurers determine where they have more flexibility with regard to insurance offerings and what they may require for their policies in order to govern where there are lacunae in the existing law. Given the prevalence of commercial space activities in the U.S. and the extent to which the U.S. is pushing the envelope of domestic space legislation, the situation in the US is extremely relevant in the context of the development of the international space industry.

FCC Regulations

In the U.S., the Federal Communications Commission (FCC) is responsible for assigning frequency allocations for all non-governmental users of spectrum,[664] pursuant to the Communications Satellite Act of 1962 and the Communications Act of 1934.[665] "The satellite space station licensing process is composed of three distinct processes: allocating available spectrum for the proposed satellite service, developing service rules and granting licenses to qualified applicants."[666] The FCC endeavors to minimize interference while maximizing the number of systems that can be utilized.[667] Moreover, federal regulations also govern the issuance of licenses for fixed microwave services.[668]

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664 FCC Online Table of Frequency Allocations, *supra* note 317.
665 Communications Satellite Act art. 201(c_(11); Communications Act titles I-III (1934).
666 Regulating Satellite Networks, *supra* note 318.
667 *Ibid*.
668 47 CFR §§ 101.4-101.97.

There are two distinct processes for assigning frequencies, one for GEO-like satellite systems with unidirectional antennae, and one for Non-GEO satellite systems, with omni-directional antennae.[669] GEO-like assignments are made on a first-come, first-served basis and are non-transferrable to any other entity.[670] On the other hand, Non-GEO assignments have a distinct processing method that differentiates between “lead applications” and “competing applications.”[671] This type of license is transferrable or assignable to another entity.[672]

The licensing of earth stations is also a function performed by the FCC.[673] When applying for an earth transmitting station license, information that must be provided to the FCC includes frequency bands, satellites to be used, power and density levels, and the diameter of the antenna,[674] with modified filing requirements for receive-only Earth stations.[675] Permission is required for a U.S. ground station to operate with a non-U.S. licensed satellite; competitive opportunities for comparable U.S. satellites and compliance with requirements to operate in the U.S. must be demonstrated.[676]

State Spaceflight Liability and Immunity Laws

The federal government is not the only actor on the U.S. space scene to promulgate governing legislation. “While states are prohibited from having laws inconsistent with federal

[669] 47 CFR §§ 25.157-25.158.
[670] 47 CFR § 25.158.
[671] 47 CFR § 25.157.
[672] *Ibid*; see also, Satellite Space Station Licensing Reform, online: FCC, <http://transition.fcc.gov/ib/sd/ssr/ssslr.html>.
[673] 47 CFR §§ 25.130-25.139.
[674] 47 CFR §§ 25.130.
[675] 47 CFR §§ 25.131.
[676] 47 CFR §§ 25.137.

law, the [Commercial Space Launch Act] specifically grants states the authority to implement law in addition to or more stringent than a requirement of, or regulation prescribed under, the Act."[677] 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.[678] Several US states have undertaken legislative activity with the intention to attract space tourism. Such state law incentives include spaceport incentives intended to leverage existing facilities, establishment of space authorities and industry-favorable liability regimes dealing with the federal informed consent rules.[679] State Spaceflight Liability and Immunity Acts will be the focus for the purposes of this section.

Virginia pioneered Spaceflight Liability and Immunity Acts for spaceflight participants (or simply "participants" as these acts universally call them) in 2007.[680] Since then, Florida, California, Texas, New Mexico and Oklahoma have followed suit,[681] with Oklahoma's adoption being the most recent in April of 2013. Several of these states are home to key spaceports that will be used by the space tourism industry, and, in fact, spacefaring entities have lobbied for these statutes. 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 re-

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[677] Commercial Space Launch Activities Act, 51 U.S.C. § 50919 (2010); Mineiro, "Assessing the Risks," *supra* note 494 at 381.
[678] Patricia Margaret Sterns & Leslie I. Tennen, "State and Municipal Regulation of the Aerospace Industry in the United States" in Ram S. Jakhu (ed) National Regulation of Space Activities (Springer, 2010) 467 at 468.
[679] Gabrynowicz, *supra* note 621 at 420.
[680] VA Spaceflight Act, *supra* note 30.
[681] FL Informed Consent, *supra* note 31; CA Spaceflight Act, *supra* note 31; TX Spaceflight Act, *supra* note 31; NM Informed Consent *supra* note 31; OK Spaceflight Act, *supra* note 31.

sulting from the risks of spaceflight activities.[682] This trend in U.S. space law is likely to have an impact on the emerging space tourism industry, and will shape that industry as it grows from its infancy.

Florida, New Mexico, and California use the word “inherent” before risks of spaceflight; thus the provision is less favorable to spaceflight entities in those states as it only protects against inherent risks, not all risks generally.[683] The Virginia, Oklahoma, and Texas Acts contain broad definitions of “spaceflight entity” which clearly protect entities such as spacecraft manufacturers that provide vehicles for use by space tourism companies. California does not include suppliers and contractors in the waiver scheme.[684] The clarity of these broad definitions are decided favorable to providers of space transportation, protecting the other entities in the chain of service.

In all cases, the participant must be presented with warning language and return a signed form evidencing that they are providing their informed consent. All but New Mexico include minimally acceptable sample language to be used. Of the sample language provided, Florida’s is the least robust.[685] It does not reference voluntary participation or informed consent. It does, however, include language demonstrating that the participant had an opportunity to consult with an attorney before signing the form.

For one example, this is the language provided by the California statute:

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[682] VA Spaceflight Act, *supra* note 30; FL Informed Consent, *supra* note 31; CA Spaceflight Act, *supra* note 31; NM Informed Consent, *supra* note 31; OK Spaceflight Act, *supra* note 31.
[683] FL Informed Consent, *supra* note 31; CA Spaceflight Act, *supra* note 31; NM Informed Consent, *supra* note 31.
[684] Schaefer, *supra* note 226 at 252.
[685] VA Spaceflight Act, *supra* note 30; FL Informed Consent, *supra* note 31; CA Spaceflight Act, *supra* note 31; OK Spaceflight Act, *supra* note 31.

> WARNING AND ACKNOWLEDGMENT: I understand and acknowledge that, under California law, there is limited civil liability for bodily injury, including death, emotional injury, or property damage, sustained by a participant as a result of the inherent risks associated with spaceflight activities provided by spaceflight entity. I have given my informed consent to participate in spaceflight activities after receiving a description of the inherent risks associated with spaceflight activities, as required by federal law pursuant to Section 50905 of Title 51 of the United States Code and Section 460.45 of Title 14 of the Code of Federal Regulations. The consent that I have given acknowledges that the inherent risks associated with spaceflight activities include, but are not limited to, risk of bodily injury, including death, emotional injury, and property damage. I understand and acknowledge that I am participating in spaceflight activities at my own risk. I have been given the opportunity to consult with an attorney before signing this statement.[686]

In all cases, liability is not waived if the appropriate warning language is not provided and signed.

All of the acts contain a list of circumstances under which a spaceflight entity will not be protected from liability. Liability for gross negligence, evidencing willful or wanton disregard for the safety of the participant, is included in all acts.[687] All six states likewise incorporate continued liability for intentionally injuring the participant or causing intentional injury to the participant.[688] The third exception, however, is only applied by Florida, New Mexico and California: when the spaceflight entity had actual knowledge or reasonably should have known of a dangerous condition.[689] This standard is more closely aligned with

[686] CA Spaceflight Act, *supra* note 31.
[687] NM Informed Consent, *supra* note 31.
[688] VA Spaceflight Act, *supra* note 30; FL Informed Consent, *supra* note 31; CA Spaceflight Act, *supra* note 31; NM Informed Consent, *supra* note 31; OK Spaceflight Act, *supra* note 31.
[689] FL Informed Consent, *supra* note 31; CA Spaceflight Act, *supra* note 31; NM Informed Consent, *supra* note 31.

standard negligence. Thus, those three states are more favorable to the spaceflight participant on that ground.

Virginia, California and Oklahoma make clear direct reference to the relevant federal law on informed consent and liability waivers,[690] while Florida and New Mexico do not.[691] Texas mentions only "language required by federal law."[692] Those statutes that include reference to the federal requirements are better drafted, in the sense that they are less likely to be found in conflict with the existing federal provisions if challenged in court.

Generally speaking, an informed consent regime is one in which an individual acquiesces to and relieves from liability for something done to her (for example, a medical procedure). This differs from the type of situation with regard to spaceflight participants, where the participant is actively engaging in an activity, more analogous to adventure tourism or extreme sports. It appears that, in the context of spaceflight participants, the US Congress had instead intended to impose what would normally be considered a duty to warn.[693] The State Acts, however, go much farther toward protecting spaceflight entities. The Commercial Space Launch Competitiveness Act may modify applicability of these individual state laws until 2025. Further discussion of this new act is included later in this chapter (under the subheading "Commercial Space Launch Competitiveness Act"), helping to identify gaps and risks, which is a necessary step to answer the research question at hand.

[690] VA Spaceflight Act, *supra* note 30; CA Spaceflight Act, *supra* note 31; OK Spaceflight Act, *supra* note 31.
[691] FL Informed Consent, *supra* note 31; NM Informed Consent, *supra* note 31.
[692] TX Spaceflight Act, *supra* note 30.
[693] Knutson, *supra* note 640 at 109.

Spaceflight Liability and Immunity Act Comparison

State	"Inherent" Risk	Sample warning language	Excludes Gross Negligence / Wanton or Willful Disregard	Excludes "Knew or Reasonably Should Have Known" of Dangerous Condition	Reference to Federal Law on Informed Consent	Broad Definition of Spaceflight Entity
New Mexico	Y	N	Y	Y	N	N
Florida	Y	Y	Y	Y	N	N
California	Y	Y	Y	Y	Y	N
Virginia	N	Y	Y	N	Y	Y
Oklahoma	N	Y	Y	N	Y	Y
Texas	N	Y	Y	N	Y (vague)	Y

Enforceability of Liability Waivers

Liability waivers are based on the principle of *volenti non fit injuria*; there is no injury to one who consents.[694] A liability waiver is a contract modifying the rights of parties under tort law, and is generally upheld in the US 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.[695] "[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."[696] Generally speaking, these waivers may not include gross negligence or recklessness, however.[697] Some courts have held such waivers against public policy where a public duty is involved,[698] which would not be the case with regard to space tourism.

Most U.S. states find these liability waivers to be enforceable for recreational activities under the common law. Courts in only 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); interestingly, Virginia holds them valid only for automobile racing.[699] As Virginia has this legislation in place, however, the legislation controls for the purposes of spaceflight activities. Even in a US state where these

[694] Suzen M. Grieshop Corrada, "Liability Waivers in the United States Travel and Adventure Sports Industry" (2006) 2006 Int'l Travel LJ 156 at 156.
[695] *Ibid* at 156-157.
[696] *Ibid* at 157.
[697] *Ibid* at 158.
[698] John O. Spengler & Bruce B. Hronek, Legal Liability in Recreation, Sports, and Tourism (Sagamore Publishing, 2011) at 69.
[699] Amaro, *supra* note 646.

would otherwise be unenforceable under the common law, if the US state with the legislation in question is the "choice of law" state in contractual or juridical terms, then it will be enforceable for the purposes of that particular case.

These forms, however are not always accepted or enforceable in other international jurisdictions, and thus may not provide a useful model moving forward with regard to the development of national or international space regulation, though they can be upheld with regard to foreign nationals as long as the U.S. state in question is the jurisdiction of choice of law. They are commonly referred to as "assumption of risk" forms in Australia, where they are still at an earlier stage in their development. Only when it can be demonstrated that the participant had a personal responsibility for their own safety are these waivers likely to be successful in Australia. In a space context, where accidents are unlikely to be caused due to the actions of the participant themselves other than simply taking the spaceflight, this manner of assumption of risk is less likely to be successful than in the United States.[700]

These waivers are likely to be enforceable in Canada, however, only where there is appropriate advance notice and the terms are clear and easy to understand.[701] In Canadian law, contracts are upheld unless they are unconscionable, which is generally only an issue where there is a problem with unequal bargaining position.[702] In this case, an individual would have the option to not agree to the terms and not travel on the spaceflight, thus there would be no such issue. It is worth noting that not all Canadian jurisdictions permit the waiv-

[700] Sue Beeton, "Horseback Tourism in Victoria, Australia: Cooperative, Proactive Crisis Management" (2001) 4:5 Current Issues in Tourism 422 at 433.
[701] Ross Cloutier et al., *Legal Liability and Risk Management in Adventure Tourism* (Hignell Printing, 2000) at 56-57.
[702] *Ibid* at 61-63.

er of gross negligence, and thus caution must be used with regard to waivers that may attempt to exclude such liability.[703]

In the European Union, such contractual waivers, including waivers with regard to space tourism, are regulated by Directive 93/13. Under this Directive, a term will be regarded as unfair if "it causes significant imbalance in the contractual rights and obligations of the parties to the detriment of the consumer.[704] The directive includes a list of potentially unfair terms, which includes such terms as exclude or limit the 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.[705] It is important to note that this provision only applies with respect to standardized "boilerplate" language, and not where such contracts are drafted on an individualized basis.

The enforceability of liability waiver provisions with regard to spaceflight participants in European jurisdictions will depend upon the implementing legislation in the relevant member state.[706] Legislation varies from those disallowing any exclusion or limitation on personal injury or death liability[707] on the one hand, to those that do not have any provisions addressing this issue either way.[708] Where implementing legislation permits a case-by-case analysis, the Directives rules regarding unfairness must be applied, taking into account the good or service

703 *Ibid* at 66-70.
704 Michael P. Chatzipanagiotis, "Regulating Suborbital Flights in Europe: Selected Issues November 19, 2012), online, SSRN: <http://ssrn.com/abstract=2177671> at 60-61; *citing*, Council Directive 93/13/EEC of 5 April 1993 OJ L 095, 21/04/1993 at 29-34.
705 Council Directive 93/13/EEC, *supra* note 704, Annex 1.
706 Chatzipanagiotis, *supra* note 704 at 63.
707 For example, § 309 Nr. 7(a) German Civil Code; Art. 33(2)(a) and 36(2)(a) Italian Consumer Code; Art. 10 bis (1) combined with the First Additional Disposition, part II, Nr. 10 of the Spanish Law 26/1984 on Consumer Protection.
708 Chatzipanagiotis *supra* note, *supra* note 704 at 62.

and all circumstances surrounding the contract's conclusion.[709] Thus, where a case-by-case analysis applies, circumstances particular to space travel will favor the acceptability of the waiver.[710] That being said, "legally speaking, informed consent only provides legal protection (defense) from the inherent risks of an activity and not from negligence, there is some confusion as to whether any private contract (release and waiver document) that seeks pre-activity exculpation from inherent risks and negligence (standard in the adventure world) would be valid"[711] – this is largely an issue of terminology.

While Spaceflight Liability and Immunity Acts and their ilk are likely to succeed at the US-level in limiting liability for space tourism operators, they are less likely to be successful in a European environment. Thus, certain US States are providing a more enticing limited liability regime for such operators while their activities are in their infancy. As space tourism transforms into an activity that is more likely to cross State lines, however, a comprehensive international regime may be necessary to reduce confusion. Given that this industry has yet to truly begin carrying spaceflight participants with any regularity, this Spaceflight Liability and Immunity Act regime is untested. It will be interesting to see how the courts apply it in the future. Regardless, now that the suborbital industry has seen its first fatality in the

[709] Council Directive 93/13/EEC *supra* note 704, Art 4(1).
[710] Chatzipanagiotis, *supra* note 704 at 62.
[711] "Study on Informed Consent for Spaceflight Participants" online: FAA, <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwj62caNmvrQAhVU_mMKHfAcCLQQFggkMAA&url=https%3A%2F%2Fwww.faa.gov%2Fabout%2Foffice_org%2Fheadquarters_offices%2Fast%2Freports_studies%2Flibrary%2Fmedia%2FInformed_Consent_for_Spaceflight_Participants.doc&usg=AFQjCNHndzBtA_5H5B0KMlca_gFCplFPpQ&sig2=Zf9yMUX3haWHpXL0FjPh6w>.

form of the October 2014 Virgin Galactic tragedy,[712] it is apparent that the "inherent risks" of space flight are here to stay, at least for a while.

Commercial Space Launch Competitiveness Act

In November 2015, U.S. president Barack Obama signed into law the amended Commercial Space Launch Competitiveness Act, also known as "An Act to facilitate a pro-growth environment for the developing commercial space industry by encouraging private sector investment and creating more stable and predictable regulatory conditions, and for other purposes."[713] The act amends Title 51 described above.[714] Though the most widely discussed provision of this act has been related to asteroid mining,[715] there are many changes to U.S. space law encapsulated within its pages that are highly relevant to this thesis. This section will discuss the relevant provisions of that Act.

[712] Tariq Malik, "Deadly SpaceShipTwo Crash Caused by Co-Pilot Error: NTSB" (28 July 2015) online: Space.com < http://www.space.com/30073-virgin-galactic-spaceshiptwo-crash-pilot-error.html>.
[713] US Commercial Space Launch Competitiveness Act, HR 2262, 25 November 2015 / Pub L No 114-90 at 1.
[714] *Ibid* at 2.
[715] See, for examples: Katrina Pascual, "U.S. Space Mining Law Is Potentially Dangerous And Illegal: How Asteroid Mining Act May Violate International Treaty" Tech Times (28 November 2015) online: TechTimes.com, <http://www.techtimes.com/articles/111534/20151128/u-s-space-mining-law-is-potentially-dangerous-and-illegal-how-asteroid-mining-act-may-violate-international-treaty.htm>; Doug Messier, "International Institute of Space Law Weighs in On Space Mining Law" Parabolic Arc (21 December 2015) online: parabolicarc.com, <http://www.parabolicarc.com/2015/12/21/international-institute-space-law-weighs-space-mining-law/>; Andrew Griffin, "Asteroid mining made legal after Barack Obama gives US citizens the right to own parts of celestial bodies" The Independent (26 November 2015) online: independent.co.uk, <http://www.independent.co.uk/news/science/asteroid-mining-made-legal-after-barack-obama-gives-us-citizens-the-right-to-own-parts-of-celestial-a6750046.html>.

In Title 1 of the Act, it calls for a reevaluation of the methodology used to compute Maximum Probable Loss in order to provide a validated risk profile.[716] In conjunction with both the commercial space sector and insurance providers, the Secretary of Transportation will evaluate and submit a report regarding the methodology used for calculating MPL, with the aim of revising the scheme to ensure that launch providers are not required to purchase excessive insurance coverage while considering the impact to industry and government of implementing the new methodology.[717] The language used, "that launch companies are not required to purchase more insurance coverage than necessary" alludes to the expense and limited availability of such coverage in a growing space sector. Minimizing excessive coverage will both reduce costs for the launch service company and also free up capacity in the space insurance market for other market participants. The Act extends the launch liability scheme to 30 September 2025,[718] after several years of short single-year extensions, signaling the intent of the government to reduce ambiguity and provide certainty for this delicate developing industry sector.

Also importantly, the act makes changes to the provisions regarding liability for spaceflight participants, which will also extend to 2025. As described above, Title 51 previously excluded spaceflight participants from the cross-waiver of liability scheme. Under the new regime, spaceflight participants are expressly included during the prescribed timeframe.[719] Licenses will, in fact, require cross waivers of liability with spaceflight participants that make personal injury, death, property damage, or loss due to activities under the license the respon-

[716] U.S. Commercial Space Launch Competitiveness Act at 3.
[717] *Ibid* at 4.
[718] *Ibid* at 5.
[719] *Ibid* at 5-6.

sibility of the spaceflight participant rather than the spaceflight provider or any other entity maintaining required cross waivers.[720] Thus, individual U.S. state spaceflight liability waiver laws cannot provide less protection for spaceflight companies than can federal law. Claims involving either spaceflight participants or third parties for losses, property damage, bodily injury, or death under licensed activities will, for now, be the exclusive jurisdiction of the federal courts.[721] Thus, state courts will be unable to hear such cases. Finally, the act replaces language distinguishing between different persons as crew or spaceflight participants in the definitions of launch and reenter / reentry, now referring to "human beings."[722] References to spaceflight participants obviously remain elsewhere in the act, and other definitions have been amended to distinguish between crew and government astronauts.

Also relevant to individual U.S. states is the call for such states and state launch facilities to "seek to take proper measures to protect themselves, to the extent of their potential liability for involvement in launch services or reentry services, and compensate third parties for possible death, bodily injury, or property damage or loss resulting from an activity carried out under a license." This provision recognizes the rapidly emerging spaceport industry; there are currently ten U.S. spaceports licensed by the FAA in seven different U.S. states.[723] Spaceport insurance is likely to be a new, growing area of the space insurance market if they continue to proliferate.

In updating the relevant legislation to cope with varied developing space technologies, the language has been modified to expressly include "reusable launch vehicles that will be

[720] *Ibid* at 9.
[721] *Ibid* at 8.
[722] *Ibid* at 23.
[723] "Active Launch Licenses" online: FAA,
<https://www.faa.gov/data_research/commercial_space_data/licenses/>.

launched into a suborbital trajectory or reentered[.]"[724] It also closes a loophole, ensuring that spaceflight companies can have both licenses and experimental permits if necessary.[725] Generally speaking, the act attempts to identify and remove duplicative requirements and any inconsistencies.[726]

Additionally, the act seeks a report to streamline the licensing and permitting process to more simply enable non-launch flight operations that are related to space transportation.[727] There is an additional call for a report to be produced by the heads of federal agencies that are relevant to space travel recommending an authorization and supervision approach that will "prioritize safety, utilize existing authorities, minimize burdens to the industry, promote the U.S. commercial space sector, and meet the United States obligations under international treaties…" though it will not impact ISS activities.[728]

The act acknowledges a need for an improved framework for space traffic management and orbital debris mitigation. To that end, it calls for a study to analyze current regulations, best practices, and industry standards as well as review all international space traffic management and orbital debris management treaties and international agreements, including non-binding agreements, to which the U.S. is a party. The issue of smallsats and their impact on space traffic management is explicitly raised, as the study calls for an assessment of the risk that they pose and any government coordination that may be necessary. The study also will contain an assessment of private sector information sharing arrangements with regard to

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724 U.S. Commercial Space Launch Competitiveness Act at 6.
725 *Ibid* at 7 & 26.
726 *Ibid* at 28.
727 *Ibid* at 8.
728 *Ibid* at 9-10.

space traffic management.[729] With regard to space situational awareness and space surveillance data, an additional report is required detailing the feasibility of processing and releasing space situational awareness data for safety purposes to any entity, accounting for national security requirements.[730]

Section 111 of the act is entitled Consensus Standards and Extension of Certain Safety Regulation Requirements. This section encourages the further development of voluntary consensus standards for the commercial space industry based on industry best practices. Reports are to be provided by the end of 2016 (not yet available) and every two and a half years thereafter through the end of 2021 on voluntary consensus standards that have been adopted, new areas that are ripe for such standards, implementation of the standards, and lessons learned about standards, best practices, and commercial space operations.[731]

The act also seeks recommendations for further legislation to "(i) streamline requirements in order to improve efficiency, reduce unnecessary costs, resolve inconsistencies, remove duplication, and minimize unwarranted constraints; and (ii) consolidate or modify requirements across affected agencies into a single application set that satisfies the requirements…" Ultimately, the act recognizes the technological and entrepreneurial developments occurring in the space industry and seeks to bolster the U.S. position as the leading host State for space commerce. A report has been produced assessing U.S. readiness to fulfill our Article VI obligations under the act. This report states that our current procedures do not adequately fulfill our duty with regard to commercial missions to celestial bodies or on-orbit ser-

[729] *Ibid* at 11-13.
[730] *Ibid* at 13.
[731] *Ibid* at 15-16.

vices activities.[732] In order to promote the development of our domestic space industry, the report states that we must provide narrow authorization procedures that protect our vital interests and fulfill our international obligations without placing an undue burden on the industry.[733] To do so, the President's office has recommended application of mission authorization legislation modeled on the FAA's payload review process.[734] It is clear that the act is meant to balance international obligations and other vital interests with a strong desire to promote the domestic U.S. space industry as much as possible. By changing the name of the Office of Space Commercialization to the Office of Space Commerce, it sends the signal that we have reached the age of private activity in space, and while the government needs to be involved in the industry, space has now been successfully commercialized. This new legislation demonstrates an effort to fill some legal gaps that exist, but in doing so, reveals the extent of legal lacunae.

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 denial of a claim.[735] Not only are technical details required by the insurer in order to initially underwrite the policy, but space insurance policies typically contain a material

[732] Holdren, *supra* note 25 at 2-3.
[733] *Ibid* at 4.
[734] *Ibid,* Appendix.
[735] Montpert, *supra* note 220 at 285.

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.[736]

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,[737] 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).[738] Items that are on the CCL are subject to the less restrictive Export Administration Regulations, which are administered by the Department of Commerce and which require a license to export. President Obama undertooktook an initiative to revise the export control regime, clarifying those items that are included on the list and those that can be moved to the CCL.[739] Revisions have been made to Category IV of the U.S. Munitions List (subject to ITARs), which includes launch vehicles.[740]

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).[741] The Directorate of Defense Trade Controls can issue authorizations in the forms of licenses, agreements, or exemptions for exports.[742] 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

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[736] Tucker, *supra* note 229 at 128.
[737] Introduction to US Export Controls, *supra* note 33.
[738] National Defense Authorization Act for Fiscal Year 2013, US Pub L 112-239.
[739] 79 FR 22740 (2013).
[740] 79 FR 34 (2013).
[741] 22 CFR § 120.17.
[742] 22 CFR § 120.

includes participation in multinational launch consortia. One example of a launch consortium including participants from multiple States that launches beyond the territory of any state is Sea Launch, which included U.S., Ukrainian, Russian, and Norwegian entities, and with that ownership, obtained a license from the FAA in March 1999.[743] Thus, even in light of U.S. export controls, Sea Launch provided a proof-of-concept in the licensing and regulation by the U.S. of international launch consortia. In the past few years, however, a Russian corporation has obtained majority ownership following a 2010 bankruptcy filing and has mothballed the floating launch platform, which it may sell.[744]

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.[745] Export controls also apply to technical data furnished to insurers, causing serious difficulty obtaining quotes for insurance premiums and obtaining reinsurance.[746] 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.[747]

[743] Joosung J. Lee, "Legal Analysis of Sea Launch License: National Security and Environmental Concerns" (2008) 24 Space Pol'y 104 at 104.
[744] "What Happened to Sea Launch" (7 September 2016) online: Space Daily, <http://www.spacedaily.com/reports/What_Happened_to_Sea_Launch_999.html>.
[745] Montpert, *supra* note 220 at 286.
[746] Matthias Creydt and Kay-Uwe Horl "Export Control Issues in Space Contracts" in Contracting for Space, Lesley Jane Smith & Ingo Baumann, eds (Burlington: Ashgate, 2012) at 293.
[747] *Ibid* at 293.

Conclusion

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. Professor Schaefer, however, maintains that "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."[748] Given the low probability of triggering the existing government indemnification limits cited by the FAA, this change is a diversion from other reforms that 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 should be a 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;[749] when they can, the intended purpose of said restrictions are eroded, as is the relevant national industry.

In terms of solely domestic claims relating to space activities, beyond what is covered in relevant statutes, it is most likely that U.S. tort law would apply and more specifically, the strict liability regime that is applied to abnormally dangerous or unusually hazardous activities.[750]

Though this chapter has not focused on issues of safety, it has addressed liability waivers that are extensively 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 in-

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[748] Schaefer, *supra* note 226 at 240.
[749] Creydt and Horl, *supra* note 746 at 291.
[750] Nesgos 1989, *supra* note 75 at 25.

surance 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."[751] 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 exists. Thus, it should not be considered that in the presence of such tools that safety will inherently or automatically degrade.

To conclude, it is critical to note that while commercial entities do not want to act under burdensome, stringent regulatory regimes, they 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.[752] Thus, for both insurers and regulators, legal certainty is a laudable goal. At the very least, carefully drafted insurance contracts can promote this type of certainty.

It is possible to produce legal certainty through careful drafting, of legislation as well as contracts; legal certainty itself does not create a regulatory burden, in fact, it can lessen that burden. For example, the Warsaw/Montreal regime discussed in Chapter 6 created legal certainty with regard to liability for passengers, baggage, and cargo in international air transportation, but in so doing actually limited liability for the air carriers in certain areas rather than creating additional burden. Additionally, if actors can verify that they were operating within prescribed regulations, there is a legal basis (though not dispositive) that there was no negligence. In a field where third party damage can be so substantial due to the nature of the activity, it is particularly helpful to promote legal certainty. The CEO of Swiss Space Sys-

[751] Christopher D. Johnson, "The Texas space flight liability act and efficient regulations for the private commercial space flight era" (2013) Acta Astronautica 226 at 233.
[752] Michael Gerhard and Kamlesh Gungaphul-Brocard "The Impact of National Space Legislation on Space Industry Contracts" in Contracting for Space, Lesley Jane Smith & Ingo Baumann, eds (Burlington: Ashgate, 2012) at 63.

tems (aka S3) expressed his desire for a level of regulation that will generate legal certainty as well, at the Aerospace Conference at ICAO in March 2015.

Looking at the comprehensive space legislation in the U.S. has demonstrated that even the most advanced domestic regimes show gaps in their law and regulations – most notably with regard to "continuous supervision" of space activities required by Article VI of the Outer Space Treaty. In an effort to promote regulatory certainty without becoming trapped in regulatory stagnation under government rules, it is possible for insurers to temporarily govern in these legal lacunae. Insurers are able to provide more meaningful oversight of their insurers on-orbit or beyond orbit activities than is currently available at a government level, at least for those space objects covered by insurance – primarily first party liability insurance, which is more likely to be carried for the life of a space object than third party liability insurance. Of course, the difficulty with this approach rests in the fact that not all satellites will carry either first or third party liability insurance beyond the third-party-required launch-plus-30-day period. The operator's liability waivers granted with regard to spaceflight participants through 2025 also degrades the (ideal) universal applicability of the insurance regime for effective governance. In both instances, however, there are still incentives to obtain insurance: for operators, to protect their own investment and/or to obtain financing and investment for their activities, and for spaceflight participants to protect themselves from possible negligence of the operators with their own personal insurance coverage. It is unlikely that a high net worth individual would be willing to fly on a space vehicle or with a space operator who was not considered insurable by the technical experts employed by space insurers. An additional limiting factor to the effectiveness of space insurers as agents of governance is the ITARs regime, which delays and makes costly the transfer of technical documentation to insurers operating outside the U.S. and/or employing non-U.S. citizens. While these challenges currently limit the effectiveness of insurers' ability to act in a governance capacity, these limitations could be lowered or altered by government action, which may still be less burdensome or difficult for government or industry than immediate government regulation of the space industry.

Chapter 8: Considerations for New Industry Groups

Introduction

While much of the space insurance industry is dedicated to the launch and operation of satellites, there are a variety of emerging space applications that carry with them unique considerations and potential legal gaps, beyond those of typical satellites, for the procurement of insurance. This chapter analyzes such applications and their special insurance considerations, including space based solar power, space based resource extraction, commercial human spaceflight, and cubesats. Insurance coverage offered to new technologies will stimulate the development of the occupations and industries that support or are supported by those technologies,[753] and thus identifying gaps that insurers can fill for these technologies provides useful answers to the parts of the research question that seek to identify legal gaps and determine whether they are the sorts of gaps that are suitable for insurer-led governance.

Space Based Solar Power

The idea of a space-based solar power system (SSP) was first pioneered in 1968 by P.E. Glaser.[754] The concept is to use human access to space in order to utilize the direct rays of the sun before they are diluted by Earth's atmosphere, allowing energy to be continuously

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753 Stone, *supra* note 153 at 69

754 P.E. Glaser "The Future of Power from the Sun," Intersociety Energy Conversion Engineering Conference (I ECEC), IEEE publication 68C-21 – Energy, 1968 at 98-103. Dr. Glaser received his first patent in 1971 and the wireless power transmission for the purposes of SSP was first successfully demonstrated at the NASA Space Antenna facility at Goldstone, CA in 1975.

collected by satellites in space for conversion to electricity and transmission to Earth.[755] There are two possibilities for wireless power transmission (WPT) of such signals to earth: microwave (this is currently the generally favored option) or by laser.[756] Unfortunately, one major problem for this concept is launch cost; economic viability is significantly hampered by the large number of launches, at a high per pound launch cost, that would be required for deploying the system.[757] For example, as many as 280 launches may be required for full deployment.[758] Likewise, given the high number of launches required for a full SPS system, environmental impact would be a significant issue. The insurance implications of the number of launches and environmental impact are not to be ignored. Most likely, the satellites used for such a system would need to be placed in GEO, either by launching and assembling them in GEO, or by assembling them in LEO and then transferring them to GEO.[759] There has been substantial development towards robotics technology that can assemble an SPS in space.[760]

With respect to SPS, the respective ITARs and EARs must be followed, and the FAA will verify appropriate licensing before a launch license is provided. Regulations will apply not only to the launch vehicles being used by the SPS entity(ies), but also to the technology

[755] P.E. Glaser "Power from the Sun: Its Future" 162 Science No. 3856 (22 November 1968) at 857; Peter E. Glaser "Space Solar Power for Earth" online: <http://www.nss.org/settlement/manufacturing/SM13.059.SpaceSolarPowerForEarth.pdf>.
[756] Space-Based Solar Power As an Opportunity for Strategic Security, National Security Space Office Interim Assessment (10 October 2007) at 7.
[757] *Ibid* at 3, 12-13, 34; Hideo Matsuoka "Global environmental issues and space solar power generation: promoting the SPS 2000 project in Japan" (1999) 21 Technology in Society 1at 11.
[758] Donald Rapp, "Solar Power Beamed from Space," (2007) 5:1 Astropolitics 63 at 65-67.
[759] For a discussion of various options for construction of a SPS, see International Union of Radio Science, White Paper on Solar Power Satellite (SPS) Systems, September 2006 (Version01Sept06), online: <http://ursi.ca/SPS-2006sept.pdf>.
[760] Susumu Sasaki, Japan Aerospace Exploration Agency, "Space Transportation for SPS" (presented in Kobe, Japan as part of SPS 2014 on 15 April 2014).

onboard SPS satellites themselves, and any rectennae or processing stations for energy that are present on the Earth.

From a liability perspective, SPS shares many potential areas of liability with other space activities; they are satellites that are launched, remain on orbit, and eventually must be dealt with as potential space debris. The high number of launches needed, however, does raise insurance costs for these forms of liability.

One unique issue for SPS, however, is the problem of "constantly transmitting energy to Earth at a level that is high enough to be useful but low enough so as not to cause any damage."[761] With regard to U.S. law, "once in orbit, the legal consequences of maintaining a SSP system, including potential damage from its wireless energy transmission, are not included [in FAA regulations] and left to general tort law in the U.S."[762] Though the U.S. government would still be responsible for providing compensation to other States under the Liability Convention, the spaceflight operator would be liable for damages in tort without receiving indemnification from the U.S. government.[763] If SSP were determined to be an ultra-hazardous activity, a strict liability regime would apply in U.S. tort law, meaning that no negligence or fault would need to be proven in order for a recovery to occur.[764] This would create a potentially dire situation from an insurance cost perspective. Otherwise, a more favorable standard negligence regime would apply.[765] "The single most important policy considera-

[761] Jeremy Singer, "Pentagon Considering Study on Space-Based Solar Power" Space News (11 April 2007) online: <http://www.space.com/businesstechnology/070411_tech_wed.html>.
[762] Ernst, *supra* note 657 at 365.
[763] Kleiman et al, *supra* note 310 at 86.
[764] Ernst, *supra* note 657 at 360-361.
[765] *Ibid*.

tion for SPS is that of WPT beam health and safety."[766] Research has shown that the type of beam used for SPS would operate below dangerous levels, regardless of whether exposure was brief, intermittent, or prolonged.[767] Frequency selection is one key factor in the safety of the beam, as higher frequencies create a more intense power beam but more efficient power transmission.[768]

Even if the beam were completely safe, harmful radio interference to other industries and services, particularly given the constant nature of power transmission, is another potential issue. While the regulation and coordination of all telecommunications services that utilize radio waves is performed through the ITU,[769] the ITU has not at this time allocated a frequency band for power transmission purposes. It would be difficult to insure an SPS system if adequate protection from harmful interference were not available under the ITU, and/or if there were a high level of likelihood that the use of such SPS systems would cause detrimental interference with other services using radio frequencies.

The success of SPS will depend heavily upon safe design and operation of the SPS, which in turn require identification of safety standards prior to design and construction. To be effective, those standards must be uniform and implemented within the existing international and national regulatory regimes. In this way, a larger number of countries could be attracted to, and served by, the project creating a larger market and a chance at eventual re-

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[766] Mankins, *supra* note 641 at 77.
[767] Gerard K. O'Neill, 2081: A Hopeful View of the Future (New York: Simon & Schuster, 1981) at 182 -83.
[768] Richard M. Dickinson, "Safety issues in SPS wireless power transmission" (2000) 16 Space Pol'y 117 at 117 -18.
[769] For details, see Constitution and Convention of the ITU, *supra* note 315 and ITU Radio Regulations, *supra* note 316; Ram Jakhu, "Regulatory Process for Communications Satellite Frequency Allocations," in Pelton J., Madry S., Camacho Lara S. (ed.), Handbook of Satellite Applications (Heidelberg: Springer Reference/Springer-Verlag Berlin, 2013) at 272-292.

turn on investment. More significantly, though, these standards would decrease the risks inherent to SPS creating less chance of liability and, again, bringing economic viability into possibility.

Environmental standards are needed in addition to safety standards. International Union of Radio Science standards must play a role in monitoring the risks present at or near ground stations, or anywhere that biota are exposed to the WPT.[770] The most effective vehicle to make SPS a reality would be an international consortium, preferably in a form reminiscent of early Intelsat/COMSAT, comprised of participants from government, industry, and academia. This model could distribute cost across users, allocate risks, and foster international cooperation. In addition, the involvement of numerous countries could facilitate harmonization of safety and environmental standards, at least among the participants. Such participation is also likely to bring down the cost of obtaining insurance, though it may complicate the relevant liability regime that will apply to the system. Strides in technology continue to make SPS more feasible, as collaborative efforts such as the SPS 2014 conference give international participants a chance to share their progress and exchange ideas and recommendations moving forward.[771]

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[770] White Paper on Solar Power Satellite (SPS) Systems, *supra* note 759.
[771] Frank Morring Jr., "Low Cost Launches May Boost Chances for Space Solar Power" (April 21, 2014) online: <http://www.aviationweek.com/Article.aspx?id=/article-xml/AW_04_21_2014_p24-678947.xml&p=1>.

Space Based Resource Extraction

One widely discussed developing area of space technology is space based resource extraction. Two companies, Planetary Resources and Deep Space Industries, have been the frontrunners in developing the relevant technologies to be able to undertake this endeavor. The uncertain status of ownership rights of resources extracted from celestial bodies under the space treaties leads to regulatory uncertainty, though this has theoretically been resolved in the context of domestic U.S. law by the Commercial Space Launch Competitiveness Act, discussed in the prior chapter. The question of whether or not large scale resource extraction and use, however, is not settled in international law, and the new U.S. legislation has been protested by several countries, including Russia, at the UNCOPUOS Legal Subcommittee in the 2016 session. This causes problems both for business plans generally, and also for insurers. Regulatory insurance, which is discussed in further detail in Chapter 10 of this thesis, could be one potential (though probably costly) solution to the business side of this problem. Unique technology considerations would also need to be taken into account, as the insuring of untested mining technologies is apt to similarly costly to insure in its first few uses as new and untested launch or suborbital technologies.

In the United States, Bill H.R. 5063 (the "American Space Technology for Exploring Resource Opportunities in Deep Space" or ASTEROIDS Act) preceded the Commercial Space Launch Competitiveness Act, and was introduced in the 2nd session of the 113th Congress to "promote the development of a commercial asteroid resources industry for outer space in the United States and to increase the exploration and utilization of asteroid resources in outer space."[772] This bill would have granted U.S. companies' rights to resources they may extract from asteroids and allow legal action in the case of "harmful interference" in those licensed activities by other U.S. entities.[773] Both Planetary Resources and Deep Space Industries supported the bill, though not without some criticism about the lack of consultation undertaken with interested parties.[774] These provisions have been included in modified form in H.R. 2262, signed into law in November 2015, which allows for the commercial recovery and ownership of space resources (abiotic resources *in situ* in outer space) by U.S. citizens, free from harmful interference.[775] The report produced by the President's office recommends adopting legislation for mission authorization that would mirror the FAA's payload review process and would satisfy the U.S.'s international obligations, particularly under the Outer Space Treaty.[776] In light of this report, requirements may include mandatory insurance, particularly if these missions are found to produce likely liability for the U.S. government under international law, which will likely choose to ensure that they are indemnified with respect to their international obligations.

As mentioned in Chapter 4, Bigelow Aerospace is also seeking clarification from the FAA regarding whether licensed placement of a commercial Moon habitat would preclude interference from other licensed U.S. actors. The request includes a proposal for a zone of

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772 US Congress, "H.R. 5063 – ASTEROIDS Act," 10 July 2014, online: <https://www.congress.gov/bill/113th-congress/house-bill/5063/text>.
773 Jeff Foust, "Hearing Raises Questions About Asteroid Mining Bill," Space News, 10 September 2014, online: <http://spacenews.com/41825hearing-raises-questions-about-asteroid-mining-bill/>.
774 *Ibid*.
775 U.S. Commercial Space Launch Competitiveness Act, Ch 513.
776 Holdren, *supra* note 25.

operation from which other U.S. entities would be excluded.[777] In a letter sent to Bigelow Aerospace in late December 2014, the FAA said it intends to "leverage the FAA's existing launch licensing authority to encourage private sector investments in space systems by ensuring that commercial activities can be conducted on a non-interference basis" and noted that the national regulatory framework in the U.S. is ill-equipped to handle some of the challenges faced in such an endeavor.[778] If these regulatory issues could be resolved, it would have a substantially positive impact on the financial feasibility of these endeavors; thus it must be considered whether insurers can provide some interim governance to assist the process of developing business best practices and subsequently, regulations.

Commercial Human Spaceflight

"The realization of affordable and safe commercial private human access to outer space may be as significant to mankind as the Wright brothers' Flyer, Gagarin's first spaceflight and the Saturn V 'Moon rocket' that put Aldrin and Armstrong on the Moon."[779] With a wide range of companies in the marketplace seeking funds and developing new and innovative space technologies, it would seem that we are well on our way to becoming a society with human access to space. Unfortunately, "[d]espite tantalizing commercial possibilities, the long-term technological and commercial viability of commercial human spaceflight remains

[777] Yves-A. Grondin, "Bigelow: Moon Property rights would help create a lunar industry," NASASpaceflight.com, 14 February 2014, online: <http://www.nasaspaceflight.com/2014/02/bigelow-moon-property-create-lunar-industry/>.
[778] Irene Klotz, "To the Moon! FAA Boosts Commercial Lunar Ventures," NBC News, 3 February 2015, online: <http://www.nbcnews.com/science/space/moon-faa-boosts-commercial-lunar-ventures-n299126>.
[779] Masson-Zwaan & Freeland, *supra* note 454 at 1597.

to be seen. Among the factors contributing to the industry's ultimate success or failure will be the application of laws and the formulation of regulations governing the carriage of human beings into space."[780]

Given the current state of development of space tourism and transportation, effective national regulations which can both foster development of the sector without undue hindrance and simultaneously foster public trust are critical for the functioning of this industry. It is important to note that, in the short term, "[m]any of the currently planned space tourism projects will operate from one and the same territory. As long as the intended vehicles will 'take off' and 'land' in that territory, the likelihood of cross-border damage is limited, and in principle that State's national law will apply, whether it concerns orbital or suborbital flight."[781] While there are a plethora of suborbital travel endeavors planned, none that have progressed significantly in their development are prepared to serve as point-to-point transportation between two States. Thus, for the time being, these activities are more likely to be governed by national laws than bilateral or multilateral agreements, acknowledging, of course, that these activities must be performed in conformity with governing treaty law and customary international law. Questions of legal liability will rise in prominence and complexity as we move closer to cross-border space transportation. The necessity for a liability regime that can both promote the growth of the space industry and adequately protect consumers cannot be over-estimated. Though regulations may only govern activities with regard to a particular State, it is still necessary for such regulations to be carefully drafted and easily comparable to the regimes of other States.

[780] Timothy Hughes & Esta Rosenburg. "Space Travel Law (And Politics): The Evolution of the Commercial Space Launch Amendments Act of 2004" (2005) 31:2 J Space L 12 at 3.
[781] Masson-Zwaan & Freeland, *supra* note 454 at 1600.

Though this section is placed in a larger context than simply a discussion of space tourism, it is useful to consider the definition of the phrase. While "[t]he term 'space tourism' has been defined as 'any commercial activity offering customers direct or indirect experience with space travel[,]'"[782] this definition seems to imply that such activities would be carried out solely for the purposes of *tourism*. It is but one of many problematic definitions in this area of legal discourse. In that vein, Professor Crowther states that "[s]pace tourism is the term commonly used to refer to ordinary members of the public buying tickets to travel to space and back[.]"[783] It is important to note that tourist activities in space for the foreseeable future are not likely to be large-scale tourist operations, but rather small scale activities with four to six seats per flight.[784] The term tourism is much more evocative of large cruise ships and sprawling resorts that are filled with tour groups and sight-seers, and thus the usefulness of the term fails in that regard. Privately funded scientific study, exploration, or human space-flight for the purposes of asteroid mining or lunar colonization would not be activities that one would readily classify as *tourism*. "[O]perators certainly are not only looking for clients among people interested in travelling into or in outer space for fun, but also for space agencies willing to pay for the training of astronauts or others willing to pay for small experiments – not touristic activities in any normal sense of the word."[785]

The European Space Agency (ESA) has defined space tourism as encompassing "the execution of suborbital flights by privately funded and/or privately operated vehicles and the

[782] Freeland, *supra* note 102 at 6.
[783] Richard Crowther, "The Regulatory Challenges of Ensuring Commercial Human Space-flight Safety" (2011) 27 Space Pol'y 74 at 74.
[784] Masson-Zwaan & Freeland, *supra* note 454 at 1599.
[785] von der Dunk, "Key Aspects" *supra* note 504 at 147.

associated technology development driven by the space tourism market[;]"[786] the term in this context is inclusive rather than exclusive, though it does not take non-touristic suborbital flights into account. The functional overlap with tourism may actually come in the form of liability waivers, disclaimers, and informed consent forms, which have previously been found national and local jurisdictions to deal with the high-risk adventure tourism activities that have preceded space tourism.[787] Certainly, at least for the time being, human spaceflight will continue to be a high-risk activity.

It is necessary to clarify the status of persons engaging in space tourism, so as to avoid confusion. Though the term "astronauts" literally "means persons who sail among the stars" and cosmonauts means "those who navigate the universe[,]" these terms are too broad, in that they include those persons traveling into space as employees or contractors for their respective governments who have extensive specialized training.[788] Those persons who might be considered "career astronauts" are not the focus of this section. The term "space tourist," which has been defined as "someone who tours or travels into, to, or through space or to a celestial body for pleasure and/or recreation[,]"[789] however, is too narrow, for the reasons discussed above; namely, that space tourism may be undertaken for purposes other than pleasure and/or recreation.

[786] ESA's Position on Privately-Funded Suborbital Spaceflight (10 April 2008) <http://esamultimedia.esa.int/docs/gsp/Suborbital_Spaceflight_ESA_Position_Paper_14April08.pdf>.
[787] Frans G. von der Dunk, "The Integrated Approach – Regulating Private Human Space-flight as Space Activity, Aircraft Operation, and High-Risk Adventure Tourism" (2012) Acta Astronautica <http://dx.doi.org/10.1016/j.actaastro.2012.05.020> at 8.
[788] Cheng, Studies*, supra* note 329 at 507.
[789] Freeland, *supra* note 102 at 6.

The US statute uses the term "space flight participant" and defines the term as follows: "an individual, who is not crew, carried within a launch vehicle or reentry vehicle,"[790] while "crew means any employee of a licensee or transferee, or of a contractor or subcontractor of a licensee or transferee, who performs activities in the course of that employment directly relating to the launch, reentry, or other operation of or in a launch vehicle or reentry vehicle that carries human beings."[791] Of course, the American definition of "space flight participant" is, like astronaut or cosmonaut, too broad from an academic perspective in the sense that it may encompass those persons who may not be career astronauts, but are still not commercially engaging in such space travel. The distinction from crew is not necessarily helpful, particularly in light of the potentially confusing difference in the definition of the same term used with regard to the ISS: "Spaceflight participants are individuals (e.g. commercial, scientific and other programs; 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."[792] Of course, "spaceflight participant" is the term that must be used from a statutory and regualtory perspective by the US, and due to its prevalence, will be used here.

For the purposes of the liability discussion here, it is to be assumed that any governing treaty provisions that are applicable to astronauts or personnel of a spacecraft would apply to spaceflight participants, and thus that such participants would, for example, be entitled to the same return and rescue efforts as any other human space traveler, trained or other-

790 Commercial Space Launch Activities Act, 51 USC § 50902 (19) (2010).
791 *Ibid* at (2).
792 Principles Regarding Processes and Criteria for Selection, Assignment, Training and Certification of ISS (Expedition and Visiting) Crewmembers, Multilateral Crew Operations Panel (November 2001) <http://esamultimedia.esa.int/docs/isscrewcriteria.pdf>.

wise.[793] For a more detailed discussion of this issue, please see the section in Chapter 2 entitled *Comparison to Mountain Climbing*.

Safety regulation is one target area to be addressed by States with active human space transportation industries. It is of particular importance given that physical dangers exist not only to third parties on the ground and in the air, but primarily also to persons aboard the craft. The goal of safety policies for manned spaceflight is a "reliability of 0.999 against a catastrophic accident defined as one in which human lives are lost" -- these are better than 1 in 1000 odds; however, from the beginning of manned spaceflight to 1993 these odds were not maintained as there were three fatal accidents among 139 missions.[794] Such odds, though, are still clearly far from optimal. Some of the dangers of human space travel have been articulated as follows:

> radiation, fire, solar flares, and equipment degradation or failure…the presence of toxic chemicals on board space craft and difficulty in providing swift and proper medical treatment…psychological stress caused by long-term isolation which will have to be dealt with and countered, crimes in outer space[.][795]

[793] See, Cheng, "Studies" *supra* note 329 at 509; Lachs, supra note 274 at 71; Mani, *supra* note 56.
[794] John H. Carver, "Factual Issues" in Karl-Heinz Böckstiegel, ed, Manned Spaceflight: Legal Aspects in the Light of Scientific and Technical Development (Cologne: Carl Heymanns Verlag, 1993) 149 at 150. For comparison, general aviation in the U.S. (much less safe than commercial aviation) results in 1.05 fatalities per 100,000 hours of flight time. Stephanie Pappas, "Why Private Planes are Nearly as Deadly as Cars" <online: LiveScience, http://www.livescience.com/49701-private-planes-safety.html>.
[795] Nicholas M. Matte, "Safety and Rescue: Introduction" in Karl-Heinz Böckstiegel, ed, Manned Spaceflight: Legal Aspects in the Light of Scientific and Technical Development (Cologne: Carl Heymanns Verlag, 1993) 145 at 147.

Of course, these dangers exist in conjunction with the dangers posed by the vacuum of space itself, such as extreme temperatures and lack of oxygen.

Safety regulation for space tourism vehicles is a critical component of a fully functional national space regulatory regime and predictable, reliable risk management.

> [O]ne of the primary hazards or risks associated with this young industry is that there are no accepted standards guiding the industry regarding critical concerns like the physical condition of the SFP [space flight participant], what gear the SFP should be required to wear, what safety equipment should be in the vehicle, what is required in a safety briefing, what type of vehicle is capable of routinely traveling to suborbital space, or even what specific categories of aircraft or specific instrument ratings a pilot must have[.][796]

Thus, this issue must be considered and addressed for the ability of this industry to flourish.

Spaceflight participant individual insurance policies will be an essential feature of commercial human spaceflight. This is particularly true in places where Spaceflight Liability and Immunity Acts are in place, and thus where there may be no other recourse for spaceflight participants and their families in the event of an accident. It would be sensible for companies (if not States) to require such insurance. The insurance industry will need to develop in order to adequately provide capacity to these individuals, though it may price individuals out of the market. While the initial participants will be high net worth individuals who can afford potentially pricey insurance premiums, this may not be the case as the cost of spaceflight continues to decrease in the future. Thus, pricing of premiums will have to evolve as these systems become safer and more reliable.

[796] Knutson, *supra* note 640 at 114.

Suborbital Spaceflight

Whether suborbital travel is considered to be space travel and thus a space activity within the meaning of the international space law regime and national space regulations or air travel under the aviation regime is a critical issue that must be resolved in order to understand which liability rules may apply. The key difference between orbital and suborbital space travel is that an orbital velocity is not achieved during suborbital spaceflights, which typically climb to an altitude around 100km.[797] To achieve orbital spaceflight, a velocity must be achieved that will follow a path consistent with the curvature of the Earth, thus preventing the vehicle from being pulled back to Earth.[798] The US defines a suborbital trajectory as follows: "the intentional flight path of a launch vehicle, re-entry vehicle, or any portion thereof, whose vacuum instantaneous impact point does not leave the surface of the Earth."[799] A vehicle would therefore be an orbital vehicle if, allowed to continue on its launch trajectory, it would not strike the surface of the Earth.

As Stephen Gorove observed, with regard to suborbital flight "[t]he main issues relate to the definition and delimitation of airspace and outer space, [discussed in Chapter 4] the status of astronauts, and the issues of liability, registration and jurisdiction."[800] Of these, the only one that is somewhat unique to suborbital flight is the problem of the definition and delimitation of airspace and outer space. As was pointed out by ICAO, the international avia-

[797] Masson-Zwaan & Freeland, *supra* note 454 at 1599.
[798] *Ibid*.
[799] Commercial Space Launch Activities Act, 51 USC § 50902 (20) (2010).
[800] Stephen Gorove, "Aerospace Object – Legal and Policy Issues for Air and Space Law" (1997) 25:2 J Space L 102 at 105.

tion regulatory regime could not and would not apply unless the space tourism involved transportation between two States.[801] Likewise, the Warsaw or Montreal Convention liability regimes would not apply for the same reason.[802] That said, the discussion of the policies implemented by the individual States discussed often give an indication of how such States view the issue. Additionally, a disharmonious series of national regulations will create a confusing regulatory environment for operators.

For this purpose, it is useful to see how these flights can be considered to fit, or not, within the treaty regimes currently. While the space law treaties do not define a space object, other than to state that it includes launch vehicles and component parts,[803] Annex 1 to the Chicago Convention does define an aircraft 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."[804] Many reusable launch vehicle concepts, particularly with regard to suborbital vehicles, can derive such support from the atmosphere, though they may only do so at certain points during their flight.

Professor von der Dunk indicates that actually deriving such support for any portion of the flight would, in fact, not be required under this definition.[805] He points out, however, that "[a]t the national level, in many cases the application of elaborate and specially crafted sets of rules is made contingent upon an aircraft belonging to a specific category of aircraft, referring to such criteria as size, use and operational characteristics, or to specific types of

[801] COPUOS, 49th Sess, C-WP/12436 of 30/05/05 (2010).
[802] Warsaw Convention, *supra* note 24; Montreal Convention, *supra* note 24.
[803] Registration Convention, *supra* note 16, art I; Liability Convention, *supra* note 16, art I.
[804] Chicago Convention, *supra* note 23, annex 1.
[805] von der Dunk, "Integrated Approach," *supra* note 787 at 6.

operations regardless of the craft used."[806] Generally, space tourism vehicles are not well suited to such established requirements.[807] Due to "distinctions in physics between 'lift' and 'thrust'" needed to accomplish a suborbital flight, that "the law [in the U.S.] classifies commercial space tourism ships as rockets, not aircraft."[808]

Professor Jakhu and Dr. Nyampong suggest that for the time being, the applicable space law responsibility and liability regime is most appropriate for commercial human spaceflight, due to the fact that such activities are still ultra-hazardous activities, and such classification would promote the appropriate regulation and supervision of those activities and increase the likelihood that compensation will be paid to victims of any damage thereunder,[809] though Professor Jakhu has urged ICAO to take jurisdiction of aerospace activities for the purposes of regulatory certainty. The scope of the Liability Convention includes an attempted launch within the definition of a launch, and therefore would be relevant to any incidents that may occur in the course of operation before the vehicle achieves substantial altitude.[810]

"Robert Heinlein famously remarked that once you've reached low-Earth orbit, you're halfway to anywhere in the solar system…at one hundred miles up, you're above the thickest of the atmosphere and the strongest gravitational pull; thus you have spent the lion's share of the fuel needed to travel" to any one of a number of relatively nearby space destina-

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[806] *Ibid* at 16.
[807] *Ibid*.
[808] Gabrynowicz, *supra* note 621 at 418; Commercial Space Transportation: Suborbital Rocket Launch Notice, 68 Fed.Reg. 59977 (20 October 2003).
[809] Ram S. Jakhu & Yaw M. Nyampong, "International Regulation of Emerging Modes of Space Transportation" in Joseph N. Pelton & Ram S. Jakhu, eds, Space Safety Regulations and Standards (Elsevier, 2010) 215 at 233.
[810] Liability Convention, *supra* note 16, Art I(b).

tions.[811] Though one hundred miles is higher than some suborbital flights will travel, the idea that escaping the atmosphere is the most important factor in space travel remains, and suborbital flights certainly reach that mark. As discussed in Chapters 5 and 6, the U.S. has deemed these activities to be space activities.[812] Though the US did not register SpaceShipOne in its national register or the UN Registry, this is permissible under the Registration Convention in that the Convention only calls for the registration of those objects launched into Earth orbit or beyond.[813] Though Professor von der Dunk calls for an alternate interpretation,[814] the US interpretation of beyond orbit evidenced by their lack of registration of suborbital vehicles is reasonable absent contrary established guidance or practice, and thus should not be considered a breach of international obligations under the treaty. Perhaps one reason that the US has utilized the option not to register suborbital vehicles is the fact that it would be subject to a cumbersome registration system under national law and does not violate the letter of the obligation (as discussed above, registration is required for space objects launched into Earth orbit or beyond, suborbital launches are not technically within this requirement). US regulations require reusable launch vehicles to be re-registered every time the vehicle is launched.[815] Interestingly, the Space Shuttles were registered a total of 125 times, in compliance with the

[811] Greg Klerkx, Lost in Space: The Fall of NASA and the Dream of a New Space Age (New York: Pantheon Books, 2004) at 91.
[812] Final Rule on Experimental Permits, *supra* note 491; van Fenema, "Suborbital Flights and ICAO" (2005) 30 Air & Space Law 396 at 408.
[813] Registration Convention, *supra* note 16, art II.
[814] Frans G. von der Dunk, "Beyond What? Beyond Earth Orbit?...! The Applicability of the Registration Convention to Private Commercial Manned Sub-Orbital Spaceflight" (2013) 43:2 Cal Western Int'l LJ 269.
[815] Commercial Space Transportation Regulations, 14 CFR §431.85 (2008).

regime being applied to orbital missions,[816] which demonstrates that the U.S. does take its registration obligation seriously when it believes that registration is required. While the American interpretation is not unreasonable, it does demonstrate that there is a gap in international registration rules where such vehicles, are not specifically registered under either air or space law. From an aircraft perspective, registration status impacts insurability and premium and thus this is likely to be an issue if aviation insurers are ultimately underwriting policies for this industry.

Orbital Spaceflight and Beyond

While orbital spaceflight and missions into space beyond orbit are more technically complex and expensive than suborbital flight, that has not prevented some private companies, for example the Sierra Nevada Corporation[817] or SpaceX, from venturing into this business.[818] Most of the planned commercial human spaceflight activities, at least those that are further along in their respective development processes, are, however, suborbital. It is conceivable that Bigelow Aerospace will, in the not too distant future, launch commercial space stations based on their BA 330 model, or even place similarly designed facilities on the

[816] Register of Space Objects, U.N. Office of Outer Space Affairs, Online Index of Objects Launched into Outer Space <http://www.oosa.unvienna.org/oosa/en/osoindex.html>.
[817] "SNC Announces First Orbital Flight of Dream Chaser® Company Outlines Plans for its Flight Operations Dream Chaser on an Atlas V" online: snccorp.com, 23 January 2014 <http://www.sncorp.com/AboutUs/NewsDetails/586>.
[818] Masson-Zwaan & Freeland, *supra* note 454 at 1599.

Moon.[819] MarsOne has proposed a likely infeasible plan to send humans on a one-way trip to Mars,[820] while some companies such as Moon Express are preparing to send humans to the Moon.[821]

While the science behind these types of missions may be vastly different from suborbital missions, from an insurance perspective, spaceflight liability insurance policies are apt to be very similar. Possible differences may include additional exclusions pertaining to actions a participant may take on the surface of a celestial body, and there may exist additional conditions relating to transfer between a space transportation vehicle and a space or celestial body-based facility.

Manned or unmanned missions to celestial bodies are likely to have unique considerations based on the design of the spacecraft to operate under the specific conditions of a particular celestial body, accounting for the qualities of atmosphere, geological composition, and any known presence of particulate matter that may be likely to damage equipment or jeopardize the mission. These considerations will be taken into account from a scientific and actuarial perspective when designing insurance policies for such activities.

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[819] "From Space Station to Moon Base – Bigelow expands on inflatable ambitions" online: nasaspaceflight.com, 30 May 2013 online: <http://www.nasaspaceflight.com/2013/05/space-station-moon-base-bigelows-expands-inflatable-ambitions/>.
[820] "Why the One-Way Trip to Mars Is Doomed to Fail" online: Popular Mechanics, 27 October 2014 online: Popular Mechanics, < http://www.popularmechanics.com/space/moon-mars/a11475/is-a-one-way-trip-to-mars-doomed-to-fail-17359519/>.
[821] Moon Express, online: <http://www.moonexpress.com>.

Cubesats

CubeSats and SmallSats (including nano and pico satellites) are a rapidly expanding area of the space industry. Though CubeSats are substantially smaller than traditional satellites, they can be used to test technologies that can later be implemented on larger satellites at a substantially lower test cost, as they are much smaller and lighter to launch and can be placed in available space on an existing rocket launch.[822] In 2014, forty-six CubeSats were launched from orbital vehicles as piggyback payloads, with an additional sixty-seven CubeSats delivered to the ISS for launching.[823] In 2015, a total of one hundred and eight CubeSats were launched, representing 49% of the total number of satellites launched, but less than 1% of total value.[824] Eighty-nine of the one hundred and nineteen U.S.-built satellites that were launched in 2015 were Cubesats.[825] CubeSats represented the majority of research and development satellites launched in 2013, but less than one percent of the revenues.[826] Ninety-one CubeSats were launched in 2013, which is more than in the prior eight years combined. Eight commercial CubeSats were launched for remote sensing and communica-

[822] SpaceDaily, "Small CubeSat Provides Big Space Experience," 26 December 2014, online: Space Daily, <http://www.spacedaily.com/reports/Small_CubeSat_Provides_Big_Space_Experience_999.html>. CubeSats consist of 1-6 units of 10x10x11cm dimensions, each under 3 lbs. CubeSats Overview, online: NASA, <https://www.nasa.gov/mission_pages/cubesats/overview>
[823] FAA, Commercial Space Transportation: 2014 Year in Review, February 2015, online: <https://www.faa.gov/about/office_org/headquarters_offices/ast/media/FAA_YIR_2014_02-25-2015.pdf> at 3.
[824] Satellite Industry Association, State of the Satellite Industry Report, June 2016, online: <http://www.sia.org/wp-content/uploads/2016/06/SSIR16-Pdf-Copy-for-Website-Compressed.pdf> at 18.
[825] *Ibid* at 19.
[826] Satellite Industry Association, State of the Satellite Industry Report, September 2014, online: <http://www.sia.org/wp-content/uploads/2014/09/SSIR-September-2014-Update.pdf> at 14.

tions purposes. Though CubeSats are primarily launched to low Earth orbit, there are various plans to send CubeSats to geostationary orbit.[827] It is plain to see that the growth in the CubeSat market raises substantial concerns for orbital crowding and space debris, which will impact insurance premium. The Satellite Industry Association reports "Growing concern regarding collisions with CubeSats – NASA first major operator to say it has moved satellites to avoid CubeSats."[828] Additionally, as the cost of launching tiny satellites is relatively low, they can sometimes be launched without proper regulatory oversight or insurance coverage in place. This possibility jeopardizes the security and safety of other satellites being launched into space, and this problem is likely to be exacerbated by the placement of such satellites in the highly valuable geostationary orbit.

Conclusion

New space technologies and innovative space activities create exciting new business opportunities for space-faring entities and insurers alike. At the same time, however, they present new challenges. We have seen in this chapter some of the gaps with regard to governance of these activities, and Office of the President in the U.S. has even acknowledged that the U.S. is not currently in a position with existing legislation to appropriately govern some

[827] Al Tadros & Dan King, SSL Payload Orbital Delivery System (PODS) "FedEx to GTO/GEO" (27 May 2015) online: icubesat, <https://icubesat.files.wordpress.com/2015/06/icubesat-2015_org_b-1-1_pods_king.pdf >; Nanosatellite & Cubesat Database (29 November 2016) online: nanosats.eu <http://www.nanosats.eu> in "Notable Upcoming Cubesat Missions."
[828] Satellite Industry Report 2016, *supra* note 824 at 21.

of them, including space-based resource extraction and beyond orbit activities.[829] Some such gaps include: the lack of a legal regime for wireless power transmission, the uncertaintainty surrounding the (international) legality of for-profit space mining, the question of whether aviation or space law regimes will apply to suborbital activities, the insufficient supervision of new/innovative space activities, and the concerns for the space environment in launching large swarms of short-duration CubeSats or other small satellites. Risk rating for innovative and untested activities is extremely difficult from an actuarial perspective, and thus insurance premiums are likely to be astronomically high (pun intended). Such high premiums could present a barrier to the conduct of the activities themselves, or to the procurement of proper first party insurance that would protect a costly investment. Start-up companies that are not well established could find themselves in very dangerous territory with regard to the status of their investors' capital or find themselves unable to procure loans or investments to undertake their activities at all. This is one of the primary reasons that it is worth exploring the possibility of leveraging different forms of insurance along with traditional space insurance to attempt to increase the feasibility of these activities, this is one means by which insurers can package insurance to reduce costs for their insureds. More importantly, however, and in partial answer to research sub-question three "what actions can [insurers] undertake to improve their ability to execute that governance function?" insurers can underwrite at the cutting edge, learning the ins and outs of these new technologies, learning to risk rate them appropriately, and setting standards for how these activities are carried out in order to obtain insurance.

[829] Holdren, *supra* note 25.

Chapter 9: Governing Insurance Policies through Interpretation

Introduction

In discussions of policy considerations, highly technical elements such as the specific drafting of contracts is left aside in favor of discussion of more "grand" issues. In this chapter, this author brings the drafting of these contracts to the forefront as a reminder of their importance. Insurance contracts and their interpretation are ultimately what will substitute for legislation or regulations in a circumstance where the insurer is performing a governance function. Therefore, this analysis is undertaken from a doctrinal perspective in order to answer research question three effectively, how insurers can govern and how they can do so successfully.

While some authors, such as Tucker, have uncovered flaws in space insurance policies, including ambiguous language, difficulty in proving loss, and mitigation and due diligence requirements on the part of the insured,[830] the literature does not reveal concrete suggestions to fix these problems. This chapter includes interpretation analysis to assist in dealing with the issue of ambiguous language. As far as mitigation and due diligence requirement are concerned, these could be managed through contractual requirements built into the relevant insurance policy language.

It is worth briefly introducing the Launch Services Agreement, which forms the core of the allocation of risk for space activities, which must implement risk allocation provisions and insurance coverages.[831] This agreement is the contract between the owner of the payload

[830] Tucker, *supra* note 229.
[831] Nesgos 1989, *supra* note 75 at 24 & 26.

and the launch supplier, governing the terms the relationship for both parties, including liability and insurance. There are multiple facets of risk that must be addressed in a Launch Services Agreement. A summary of risk allocation for commercial space transportation is as follows:

1. Participants assume risk of loss to their own property and would, therefore, obtain property insurance or bear the loss;
2. By contractually agreeing to waive claims among themselves, participants substantially reduce the likelihood of litigation that might arise resulting from a failed launch;
3. As regards third parties having nothing to do with launch activities, comprehensive general liability insurance would be necessary to provide for legal liability of participants.[832]

These common risk allocation principles greatly simplify the launch services process and States may require third party insurance to protect them from incurring liability under international law.

Part A: Insurance Contract Interpretation Principles

In addition to the Launch Services Agreement, the launch contract itself is an important document that will be used to establish rules of behavior for both the insured and the insurer and to adjudicate claims. Thus, the interpretation of these documents is of essential importance in determining the effectiveness of the policy. Interpretation is often considered a

[832] Nesgos 1989, *supra* note 75 at 24.

tool to clarify ambiguity in a contract or treaty. Ambiguity can be either ambiguity (a term has multiple meanings) or syntactic (lack of clarity on what is modified by use of the term) or contextual (inconsistent provisions).[833] Ambiguity and vagueness are not the same; vagueness arises from a lack of clear delineation of boundaries or varies depending on context.[834] For example, legal use of the term 'space' in an international context is vague because there are no defined legal parameters.

Though rules of treaty interpretation have been developed in modern international law and codified in the Vienna Convention on the Law of Treaties, a different set of rules applies to the interpretation of private contracts depending on jurisdiction. More specifically, a subset of standard contract law applies particularly to insurance contracts. Due to the prevalence of Lloyd's policies in the space insurance market, the rules of interpretation discussed here are those of the common law system, largely with a focus on the United Kingdom. The striking similarities of some of the basic principles of private contract interpretation and treaty interpretation provides another indicator of the ways in which insurers have the tools to operate as a form of governance at a national or international level.

The drafting detail of insurance contracts has traditionally not been a priority, both because clauses tend to remain very similar to other clauses that have come before and also because the drafters' focus is not sufficiently placed on the accurate expression of the parties' intentions, but is often hindered by lack of training, lack of legal input, and / or the pressures of time and economics.[835] Often, the contract is not closely assessed until or unless a problem

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[833] Tina L. Stark, *Drafting Contracts: How and Why Lawyers Do What They Do* (New York: Aspen Publishers, 2007) at 235-236.
[834] *Ibid* at 236.
[835] Henley, *supra* note 218 at 67.

or claim arises, at which point the wording is carefully analyzed with reference to the events at hand. The results of this analysis can lead to settlements or court proceedings, if the parties do not agree. The difficulty here is that contract language can be vague, and unfortunately, it is sometimes intentionally so, for the purpose of reaching an easier agreement;[836] as we can see from the Outer Space Treaty and its progeny, this is also true in the practice of treaty drafting.

Under the objective English law of contract construction, the focus is on finding the parties' intentions in the language they used, when considered by reasonable persons in the circumstances of the parties when contracting.[837] Like space insurance, contracts in general are not made in a vacuum; they must be placed in their setting which includes the surrounding circumstances such as commercial purpose, background, context, and market.[838] Included in context are specific usage within a locality (not terribly relevant in a space context) or particular trade,[839] or the technical meaning of a term as long as both parties can be reasonably expected to know the technical term.[840]

Likewise, treaty interpretation as reflected in the Vienna Convention, is carried out in such a way to establish the intention of the parties. Intepretation in good faith, in context and in light of the object and purpose of the treaty,[841] at a fundamental level seeks to understand

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[836] HIH Casualty and General Insurance Ltd v New Hampshire Insurance Co, *supra* note 217, para 9 *citing* E E Caledonia Ltd v Orbit Valve Co [1994] 1 WLR 1515 at 1523H.
[837] Lord Hoffmann "The Intolerable Wrestle with Words and Meanings" (1997) 114 SA J 656 at 664; see also, The Starsin [2004] 1 AC 715, para 73.
[838] Reardon Smith Line v. Yngvar Hansen-Tangen, "The Diana Prosperity" [1976] 1 WLR 989; Arbuthnott v Fagan [1996] LLRL 135 at 139.
[839] Team Services v Kier Management and Design Ltd [1993] 63 BLR 76.
[840] Bank of Credit and Commerce International SA v Ali [2002] 1 AC 251; see also, The Starsin, *supra* note 837 at para 73.
[841] VCLT, *supra* note 110, art 31.1.

the intent of the parties (as the parties establish the object and purpose). Other agreements and the practices of the parties are also used in order to help establish their intent and thus interpret the treaty at hand.[842] Finally, "if it is established that the parties so intended" a special meaning can be given to a term.[843] Thus, we see both in private insurance contracts and in international treaties, *intent* is king.

The contracting rule of *contra proferentem* (ambiguity will be decided against the drafter)[844] will hold more often in cases regarding insurance contracts than some other areas of contract law, largely because of the perceived imbalance between insurers and insured in determining the wording.[845] This rule has been codified in several international instruments, including the UNIDROIT Principles[846] (non-binding) and the Principles of European Contract Law (non-binding, but representative of core legal rules in the Member States).[847] This is likely to be less true when it comes to space insurance contracts, which are formed with more sophisticated insureds, particularly in the case of large corporations that have been the traditional users of space. The rule will be more valuable, however, as more small start-ups continue to form and launch smallsats. Even better funded ventures may lack an intricate legal understanding of the space insurance world. It is possible to contract out of the *contra proferentem* rule with a clause that states that the contract shall not be interpreted against ei-

[842] *Ibid*, art 31.2 – 31.3.
[843] VCLT, *supra* note 110, art 31.4.
[844] Bramall & Ogden v Sheffield City Council (1983) 29 BLR 73.
[845] Re Drake Insurance plc [2001] Lloyd's Rep IR 643.
[846] UNIDROIT Principles online: UNIDROIT, <http://www.unidroit.org/english/principles/contracts/principles2010/integralversionprinciples2010-e.pdf>, art 4.6.
[847] Principles of European Contract Law, online: <http://www.cisg.law.pace.edu/cisg/text/textef.html#a5103 > at 5:103.

ther party due to authorship alone.[848] Though the principle of *contra proferentem* is not expressly contained in the VCLT, it can find its place in both good faith application of treaties (manipulative drafting is not in good faith) and in customary norms.[849]

Business common sense will trump the semantic and syntactical analysis of words in such a contract.[850] This is called a purposive interpretation.[851] It is important to note, however, that the court will not redraft a contract in order to achieve a reasonable result in the eyes of the court.[852] This is one area where there is disagreement between contract interpretation and Vienna Convention treaty interpretation rules, as it states that treaties will not be interpreted in such a way as to produce an absurd result.[853] Thus, they can be reinterpreted to reach a non-absurd (or reasonable) result. In terms of private contract law, where two clauses apparently conflict; one should be clearly stated to be notwithstanding or subject to the other clause to clarify which clause will control.[854] While there is no such specific provision present in the Vienna Convention, it does specify clear rules for the separating treaty provisions in cases where such is necessary.[855]

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[848] Henley, *supra* note 218 at 140.
[849] Ulf Linderfalk, On the Interpretation of Treaties: The Modern International Law as Expressed in the 1969 Vienna Convention on the Law of Treaties (Dordrecht: Springer, 2007) at 284-285.
[850] Antaios Cia Naviera SA v Salen Rederiena AB, 'The Antaios' [1984] 3 AER 229 at 233, [1985] AC 191 at 202; see also, Glynn v Margetson & Co [1893] AC 351 at 359; see also, UNIDROIT Principles, *supra* note 846, art 4.1(2).
[851] Mannai Investment Co Limited v Eagle Star Life Assurance Co Limited [1997] AC 749.
[852] Kazakstan Wool Processors (Europe) Ltd v Nederlandsche Credietverzekering Maatschappij N.V. [2000] Lloyd's Rep. IR 371, paras 46 & 49; Charter Reinsurance Co. Ltd v Fagan [1997] AC 313.
[853] VCLT, *supra* note 110, art 32(b).
[854] Henley, *supra* note 218 at 136-137.
[855] VCLT, *supra* note 110, art 44.

A term that is specifically agreed between the parties will trump any standard form in the contract.[856] This is for the purpose of achieving the intent of the parties, which is a key element of the interpretation process.[857] That said, there are circumstances in which a term may be implied into a contract that was neither included as standard form nor specifically agreed by the parties. If a term would be included as a function of the particular insurance market that is applicable throughout it and that is also notorious, certain, reasonable, and generally deemed to be binding in the market in question.[858]

Part B: Key Features of an Insurance Policy

Precaution leads us somewhat away from insurance, where insurers are also understandably leery about covering losses that may be serious and irreversible. The logic of precaution increases the importance of contractually defining the covered risks in terms of fixing coverage limits or claims durations.[859] Unique risks in the form of commercial space activities often warrant individual negotiated policies known as manuscripted policies, which are drafted by practitioners who interpret insurance policies and contracts on behalf of the insureds, the brokers, or the insurers.[860]

In general, the standard features of an insurance policy remain the same whether they are space insurance policies or other types of risks. Critically, the following elements will

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[856] Henley, *supra* note 218 at 135.
[857] UNIDROIT Principles, *supra* note 846, art 4.1.
[858] Henley, *supra* note 218 at 176-177.
[859] Ewald *supra* note 62 at 298.
[860] Nesgos 1989, *supra* note 75 at 26.

need to be identified: the subject matter of the insurance, the time period covered by the policy, the financial limits of the policy, and the generic risks that will be covered.[861]

The London Market Group, previously known as the Market Reform Group, which is an industry-led initiative for the London subscription market, provided nine attributes of contract certainty in its November 2005 report. These elements are:

1. Wording (e.g. consistent, coherent, complete);
2. Law, jurisdiction, arbitration (e.g. choice of law and jurisdiction defined;
3. Commercial Terms (e.g. premium and brokerage defined);
4. Risk disclosures (e.g. clear reference to supporting information);
5. A single agreed version (e.g. available to all, definitive, timely);
6. Compliance (e.g. meets relevant regulatory requirements);
7. Sound legal basis (e.g. several liability clearly established);
8. Comprehensible (e.g. plain English); and
9. Duties clearly allocated (e.g. basis of agreement to contract changes).[862]

In addition, there are several categories of contract terms, primarily: conditions, conditions precedent, warranties, and terms delimiting the risk.[863]

Private contracts, and even more particularly insurance policies, which are formulaic in the sense that they contain a set of standard types of clauses to deal with a variety of issues of both coverage and procedure, are tools of governance. They act as legislation that binds the individual entities to abide by the rules of their governing authorities, in this case, the insur-

[861] Henley, *supra* note 218 at 66.
[862] Henley, *supra* note 218 at 75-78.
[863] *Ibid* at 198.

ers. As can be seen from the descriptions of usual insurance contract clauses below, insurers are governing the behavior of their insureds in a precise and structured manner.

The sections below are not intended to provide an exhaustive list and explanation of each section of an insurance policy, but to address those sections that may be particularly relevant and noteworthy in the area of space insurance as governance.

Operative Clauses

The operative clauses are the bread and butter of the insurance policy, setting forth a basic explanation of what is intended to be covered by a policy and what is not, as well as which events will be covered (i.e., is coverage based on the date of the occurrence, or when claims are filed). In general contracting terms, these can also be called *action sections.*[864] Operative clauses are refined into a full agreement by the other sections of the contract.

As mentioned above, space insurance policies are generally all perils policies, but what does that mean? This means that included perils are *eiusdem generis*, or the perils of space activities or otherwise specifically mentioned. This follows on from the rule that applies to marine policies, where perils of the sea or perils thereof are covered.[865]

[864] Stark, *supra* note 833 at 95-107.
[865] Thames and Mersey Marine Insurance Co v Hamilton, Fraser & Co [1887] 12 App Cas 494.

Definitions

Definitions are essential to contract interpretation, and are generally very detailed in insurance policies. The purpose of including a definitions section in the policy is to shorten drafting, thereby reducing excessive repetition, and it also makes it possible to reuse the form or parts of it in different circumstances, making it more easily amendable.[866] Defined words in general are capitalized in an insurances policies,[867] but the capitalization of a word does render it any special significance if there is no actual definition included in the contract.[868] If there are more than a few definitions, they should appear in their own section rather than embedded in the contract, but if there are only a small number of definitions, they can be included in the first instance of their use.[869] Definitions can be used in the following ways to modify a term: expand, limit, clarify, resolve ambiguity, explain technical meaning, express a transaction-specific concept.[870]

If the parties agree to a specific definition within the four corners of the contract, then the courts will apply that meaning.[871] Use of such a definition strips the word of its natural meaning and applies the meaning agreed by the parties, such that they could have used a symbol or a formula rather than a word to achieve the same meaning,[872] though the word used as a label can help to clarify any ambiguities.[873]

[866] AIB Group (UK) plc v Martin [2002] 1 WLR 94 at para 8.
[867] Henley, *supra* note 218 at 127.
[868] Charter Reinsurance Co Ltd v Fagan, *supra* note 852 at 386.
[869] Henley, *supra* note 218 at 130.
[870] Stark, *supra* note 833 at 73.
[871] Henley, *supra* note 218 at 126.
[872] Chartbrook Ltd v Persimmon Homes Ltd [2007] EWHC 409.
[873] Chartbrook Ltd v Persimmon Homes Ltd (Appeal) [2009] UKHL 38 at para 16.

Appropriately drafted definitions will not utilize circular definitions (an example of a circular definition is the definition of a space object in the Registration and Liability Conventions) or include rights or obligations within their text; they should appear once and use the present tense.[874] Parties by and large may not sue on a definition,[875] and generally speaking, definitions are less likely to be interfered with than other insurance contract terms.[876] One poorly drafted definition can spell disaster for the interpretation of an entire contract or treaty.

Exclusions

Exclusions are what they sound like: clauses that explain what occurrences will not be covered even though they would otherwise be covered by the operative clauses/insuring agreements. They are losses not covered by the insurer to avoid particularly high risk or costly activities not adequately compensated for by the premium.[877] They run the gamut from broad, obviously excluded events that would not be covered by the type of policy at hand, to carefully crafted relevant exclusions with "carvebacks" or "carve outs" setting forth certain exceptions that are not actually excluded. If certain actions or inactions of the insureds are meant to be excluded from coverage, then it must be specifically stated as such in an exclusion.[878]

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[874] Henley, *supra* note 218 at 129-130.
[875] Stark, *supra* note 833 at 83.
[876] Henley, *supra* note 218 at 130.
[877] Definition of 'Exclusions', Economic Times, online: India Times < http://economictimes.indiatimes.com/definition/exclusions>.
[878] Henley, *supra* note 218 at 369.

One common exclusion deals with the issue of consequential losses, which can be narrowly or broadly defined. Consequential losses include loss of profits (pure economic loss) and / or losses that are too remote or not a direct result of material damage.[879] The term indirect loss can also be used to describe damages that are not a direct result of the loss, where the nexus is insufficient to connect the damages with the loss-causing event.[880] It is acceptable to utilize a broad view of the applicability of these exclusions.[881] Consequential loss exclusions are particularly relevant with regard to coverage for space activities, given the lack of clarity surrounding the definition of damage under the liability convention discussed in Chapter 4. It could be problematic for a State if a loss was found to include indirect damage at an international level, but the insurance only covered direct damages. Thus, it would be in States' best interests to include provisions regarding whether indirect damages would be included in mandatory insurance contracts. Regardless, a clear definition of damage is essential to a well-drafted insurance policy.

Cyber risks are often excluded from non-cyber policies. Typically, cyber risks include data breach, data destruction or corruption, and computer viruses. Data-related losses are particularly relevant to space assets, given the data that is often transmitted by satellite. Though cyber risks may be excluded, it is possible to purchase separate cyber policies to cover such losses.[882] This form of insurance is discussed as applied to space in Chapter 10 below.

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[879] *Ibid* at 294-295.
[880] *Ibid*.
[881] Environmental Systems Pty Ltd v Peerless Holdings Pty Ltd [2008] VSCA 26; see also "Exclusion of liability – Consequential Loss" online: Norton Rose Fulbright < http://www.nortonrosefulbright.com/knowledge/publications/119908/exclusion-of-liability-consequential-loss>.
[882] Henley, *supra* note 218 at at 304.

War risks are likewise often excluded from policies, including space insurance policies. This could be a tricky exclusion if conflict in space arises in the future, as such conflict is likely to be carried out through unconventional means and may cause temporary business interruption or substantial permanent loss to space assets. The general test for whether or not a circumstance can be considered war for the purposes of a war exclusion is as follows:[883]

1) Is there a conflict between opposing sides?
2) What were the objectives pursued in causing the damage and how were they pursued?
3) What was the scale of the conflict and how did it impact the general public as well as the public order?

While this test sets out useful parameters, the definition of war and conflicts in space are evolving at such a pace that the parties should be as careful in drafting a war exclusion as possible. Standard terrorism exclusions would generally include cyber attacks in the exclusion,[884] thus cyber attacks on space assets would not be covered by the policy (though they would likely not be covered anyway due to the cyber exclusion, unless a cyber policy or endorsement were purchased for additional premium).

Subjectivities

Insurers will sometimes make a contract subject to a certain condition, which can create three outcomes: there is no contract because agreement to agree terms have not been satisfied, there is no binding agreement because the contract is suspended until discharged, or per-

[883] Spinneys (1948) Ltd v Royal Insurance Co Ltd (1980) 1 Lloyd's Rep 406 at 428.
[884] Tektrol Ltd v International Insurance Co of Hanover Ltd [2006] Lloyd's Rep IR 38, para 20.

formance of the contract is suspended until a condition is satisfied.[885] Subjectivities are the responsibility of the insured to fulfill.[886]

"A subjectivity should set out the following:

1) The condition/action that needs to occur, by whom and to what standard;
2) The applicable timescale, if any, within which the condition is to be met;
3) The terms which are to apply until the condition is met;
4) Any consequences which follow if the condition is not met."[887]

Some common subjectivities include provision of certain information, including that regarding: qualifications, loss runs and expiring coverage, financials, and a safety plan.[888]

Conditions and Conditions Precedent

Breaches of simple conditions that are not conditions precedent will only be repudiatory in a circumstance where the term goes to the root of the contract.[889] A condition precedent must be strictly complied with.[890] If it is not, then termination of the policy or, more commonly, a discharge of the insurers responsibility to pay the claim, will result.[891] Though simply labeling a term as a condition precedent is not sufficient in and of itself for a court to deem

[885] Henley, *supra* note 218 at at 100.
[886] *Ibid* at 101.
[887] Contract Certainty Code Principles & Guidance, Market Reform Group (June 2007) online: InsureReinsure.com, <http://www.insurereinsure.com/files/upload/521[1].pdf?download>.
[888] "Understanding Subjectivities on a Quote" online: (24 November 2015) PartnerOne Environmental, < http://p1enviro.com/recent-activity/understanding-subjectivities-on-a-quote/>.
[889] Henley, *supra* note 218 at at 198.
[890] AIG Europe (Ireland) Ltd v Faraday Capital [2007] Lloyd's Rep IR 267 at para 23(3).
[891] Kazakstan Wool Processors (Europe), *supra* note 852.

it as such.[892] However, the absence of the words "condition precedent" can be used by the court to construe that a clause was never meant as such,[893] though it is not precluded from being construed as a condition precedent.[894] It is important that an insurer establish a clear link between the obligation of the insured incurred through the condition precedent and the liability of the insurer that attaches.[895]

Warranties

According to the Marine Insurance Act of 1906 (UK), a warranty can be defined as "a promissory warranty, that is to say, a warranty by which the assured undertakes that some particular thing shall or shall not be done, or that some condition shall be fulfilled, or whereby he affirms or negatives the existence of a particular state of facts."[896] Courts have extended the marine ideology of warranties to other non-marine insurance coverage.[897] Traditionally, warranties can be divided into present warranties, which are also known as representations, as they must be true at the time of contract, or future warranties that must be complied

[892] Alfred McAlpine v BAI [1998] 2 Lloyd's Rep 694 at 700; Aspen Insurance UK Ltd v Pectel [2009] Lloyd's Rep IR 440 at para 8.
[893] Municipal Mutual Insurance Ltd v Sea Insurance Co Ltd [1996] 2 Lloyd's Rep 265 at 274-275.
[894] George Hunt Cranes Ltd v Scottish Boiler and General Insurance Co Ltd [2002] Lloyd's Rep IR 178 at para 11.
[895] Friends Provident Life and Pensions Ltd v Sirius International Insurance Corp [2006] Lloyd's Rep IR 45.
[896] Marine Insurance Act (1906) Regional 6 Edw 7 online: UK Government Legislation, <www.legislation.gov.uk/ukpga/Edw7/6/41/section/33> at 33(1).
[897] HIH Casualty and General Insurance Limited v New Hampshire Insurance Company, *supra* note 217 at para 122.

with throughout the course of the period of insurance.[898] Similarly to conditions precedent, warranties do not need to use the term “warranty” to be deemed a warranty by the courts, as long as the intention is obvious.[899] Generally speaking, insurers will require a signed declaration on the application or quotation form that the information given in the form is warranted correct.[900] In order for an insurer to be liable to pay a claim, compliance with each warranty is required.[901] A breach of warranty will entitle an insurer to deny liability for losses following the breach regardless of the nexus or lack thereof between the loss and the breach,[902] unless the contract contains a clause that states otherwise.[903] There are some circumstances under which a warranty breach can be excused, such as change of circumstances where the warranty is no longer applicable to the circumstances of the contract or the warranty becomes unlawful due to subsequent law.[904] An insurer can waive a breach of warranty if it so chooses.[905]

In warranting that all relevant information has been included, it is important to ensure that all material facts are disclosed. In order to be material, a fact does not need to decisively impact the underwriter, nor does it necessarily simply increase the risk, but is a fact that the underwriter would want to know in deciding whether to insure the client and in rating the risk.[906] Contracts for space insurance generally also require that any material changes be disclosed to the insurer during the period of insurance. Such alterations can lead increases in

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[898] Pawson v Watson (1717) 2 Cowp 785.
[899] De Maurier (Jewels) Ltd v Bastion Insurance Co [1967] 3 Lloyd’s Rep 550.
[900] Henley, *supra* note 218 at 213-214.
[901] Marine Insurance Act, *supra* note 896 at 33(3).
[902] Dawsons Ltd v Bonnin [1922] 2 AC 413.
[903] Kumar v AGF Insurance Ltd [1998] Lloyd’s Rep IR 502.
[904] Marine Insurance Act, *supra* note 896 at 34(1).
[905] *Ibid* at 34(3).
[906] Henley, *supra* note 218 at 365.

risk. Under the English courts, "[i]t will only be when the insurer is being asked to take on some additional risk and/or needing to reassess the premium or terms to cover the disclosure of a further fact which could be material and, even then, the facts to be disclosed are only those which are material to what the insurer is being asked to do."[907] Warranties are used when there is justifiable reliance on the state of facts warranted in order to appropriately allocate risk.[908]

To place included information clearly outside the boundaries of warranty that could negatively affect coverage, it is prudent to include wording such as information not warranted.[909] Otherwise, an unqualified representation might give rise to a right for the insurer to avoid coverage.[910]

Dispute Resolution Clauses

Dispute resolution clauses are common and are very helpful in minimizing the costs to both the insured and the insurer in the case of a dispute. Common forms of clauses dealing with dispute resolution are choice of law, jurisdiction, and arbitration, mediation, expert determination, or early neutral evaluation.[911] It is also possible to specify any dispute areas that the parties do not wish to be subject to the dispute resolution clause.[912] There is reluctance in the London market to utilize domestic U.S. arbitration clauses because of the differences in

[907] Iron Trades Mutual Insurance Co Ltd v Companhia de Seguros de Imperio [1991] 1 Re LR 213.
[908] Stark, *supra* note 833 at 118-119.
[909] Henley, *supra* note 218 at 407.
[910] Highland Insurance Co v Continental Insurance Co [1987] Lloyd's Rep 109.
[911] Henley, *supra* note 218 at 310.
[912] *Ibid* at 312.

law, the wide range of possibilities for awards, and the difficulty of appealing those awards.[913]

The Optional Rules for Arbitration of Disputes Relating to Outer Space Activities, put forth by the Permanent Court of Arbitration (PCA), provides sample language for an arbitration clause in cases where the parties wish to implement the Optional Rules.[914] If the parties agree to refer a dispute to the PCA under these Optional Rules, then a "waiver of any right to immunity from jurisdiction, in respect of the dispute in question, to which such party might otherwise be entitled" will be constituted; it is not necessary for a jurisdiction to characterize the dispute as specifically relating to outer space for the rules to apply.[915] The Optional Rules are based on and modify the 2010 UNCITRAL Arbitration Rules to address the particular needs of this subject area,[916] and govern the relevant issues with regard to arbitration including notice, representation, number and selection of arbitrators, and procedures to be followed. These rules could be effectively applied with regard to space insurance disputes.

[913] *Ibid* at 314.
[914] Optional Rules for Arbitration of Disputes Relating to Outer Space Activities, Permanent Court of Arbitration (6 Dec 2011) available at: <http://pca-cpa.org/shownews.asp?ac=view&pag_id=1261&nws_id=323>, Annex.
[915] *Ibid*, art 1.
[916] *Ibid*, Introduction.

Other Standard Clauses

Recitals simply state a factual basis for the agreement and should state the joint intention of the parties to the contract.[917] They provide background context for the contract, and as unenforceable provisions, simply explain why the parties are entering into the contract.[918]

Innominate (or unclassified) terms are secondary terms that do not relate to the specific risks involved in the insurance contract nor are they essential to the coverage, but they enable the smooth functioning of the contract, e.g. notice provisions.[919] These provisions allow a balancing of the severity of the breach and the remedy with the prejudice caused to the insurer, with only sufficiently serious breaches permitting discharge of the contract.[920] As the law in this area has evolved, it has become more likely that breaches of such a term will incur damages payable by the insured, but will not defeat a claim wholesale.[921]

Given that space law is still relatively undeveloped and is currently evolving with the changes in technology and evolution of space commerce, it is relatively likely that changes in law might occur over the course of a contract of insurance for a satellite, particularly if a satellite is insured on-orbit for a substantial portion of its life (though this insurance is generally purchased in one year increments). Insurers can use change in law clauses to address this eventuality in contract, and should do so in the case of space to protect their own assets. Unfortunately, often times these clauses are phrased as agreements to agree to reform effected

[917] Henley, *supra* note 218 at 134.
[918] Stark, *supra* note 833 at 38.
[919] Henley, *supra* note 218 at 222.
[920] Alfred McAlpine v BAI (Run-Off) Ltd. [2000] 1 Lloyd's Rep 437 at 444.
[921] Friends Provident Life & Pensions Ltd v Sirius International Insurance Corp [2005] Lloyd's Rep 517, para 33.

provisions of the contract with the change in law, and thus have no actual legal effect.[922] One option is for the clause to include a provision that agreement must be made within a certain timeframe or a mutually agreed third party will adjudicate and amend the language as necessary.[923] In the case where no such clause exists, the insurer(s) will be on the hook for any change, which could materially increase exposure.[924] In the case of space insurance, if the change effects several large risks for an insurer, it could have a substantial impact on the insurance market.

A version of a cross liability clause in insurance policies makes clear that every involved entity is separate and not a joint coinsured, therefore there is no right of subrogation against a party that would otherwise be liable.[925] These clauses are relevant and useful where cross-waivers of liability are present and required for entities operating under U.S. space law. Of course, there are a number of other standard clauses that are present in many forms of contract, including space insurance contracts, that have not been specifically analyzed here, given that they do not express any unique issues in the field of space insurance or insurance generally. One example of this is the entire agreement clause, which specifies the documents that can be taken into account in understanding the agreement between the parties, to limit what may be brought in as additional evidence of the agreement between the parties.

It is possible to include a long term agreement clause, which is one sided in the sense that the insurer is not required to accept the insureds offer of renewal, but gives the oppor-

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[922] May & Butcher v R [1934] 2 KB 17; Walford v Miles [1992] 2 AC 128.
[923] Henley, *supra* note 218 at 266.
[924] Lexington Insurance Company v WASA International Insurance Company [2009] UKHL 40.
[925] Henley, *supra* note 218 at 299.

tunity for premium savings to the insured when renewing.[926] These clauses are likely to be useful for on-orbit policies where there is expected to be long-term insurance coverage during the life of the satellite.

Though it is true that losses that could have easily been avoided will not be recoverable,[927] it is also wise for an insurer to include a clause that required an insured to mitigate losses that occur and to preserve their rights as against third parties as a result of a loss.[928] Duties to mitigate only attach after a loss, not before it, so insurers are not liable for costs incurred to avoid a loss.[929] This is notable with regard to space situational awareness, where costs will often be incurred by an insured in terms of reduced fuel limiting the life of the satellite or temporary loss of service if they choose to maneuver a satellite out of the way of a piece of debris or satellite with which it may collide. A clause can be included, however, to require that insureds take reasonable precautions to avoid loss, even at their own expense.[930] These generally stated clauses are only effective, however, when the insured acts recklessly.[931]

[926] *Ibid* at 424.
[927] See, for example, Yorkshire Water Services Ltd v Sun Alliance plc [1997] Lloyd's Rep 21 at 32.
[928] Henley, *supra* note 218 at 430-431.
[929] Yorkshire Water Services Ltd v Sun Alliance plc [1997] 2 Lloyd's Rep 21.
[930] Henley, *supra* note 218 at 465.
[931] See for example, The Scottish Coal Company Ltd v Royal and Sun Alliance PLc [2008] Lloyd's Rep IR 718, paras 111-115.

Endorsements or "Riders"

Endorsements can add almost anything to an insurance policy - new operative clauses, definitions, exclusions, etc. They range from single sentence documents to many page modifications changing many clauses. Endorsements can be used to make a policy more specialized for a particular risk, to update older policy wordings to reflect changes in the market, or to offer standard coverage add-ons. This section provides a discussion and analysis of some endorsements to space insurance policies.

Endorsements can be used to delete a clause from a standard form contract, or to delete a clause that was previously agreed where circumstances have changed. In these cases, the deletion can be used in the interpretation of the contract that remains as evidence of the parties intention, though it is not in and of itself determinative.[932] If a leading underwriter agreement is in place, the lead underwriter can agree to endorsements to the policy without obtaining agreement from all of the other involved underwriters, and they will still be bound by the changes. In effect, the lead underwriter becomes the agent for all of the underwriters involved in the policy.[933] This authority, however, does not include the authority to agree a material alteration of the risk.[934]

[932] Mottran Consultants v Sunley (Bernard) & Sons Ltd [1975] 2 Lloyd's Rep 197; Doheny v New India Assurance Co Ltd [2005] Lloyd's Rep IR 251 at paras 26-27.
[933] Insurance Co of the State of Pennsylvania v Grand Union Insurance Co [1990] 1 Lloyd's Rep 208 at 224.
[934] Barlee Maritime Corporation v Mountain ("The Leegas") [1987] 1 Lloyd's Rep 471.

Final Principles

It is notable that a clause can be severed from the contract if the clause itself is unenforceable for one reason or another. The test that is applied in this case is a three step test that evaluates first whether the provision that is unenforceable can be removed without a need to add to or modify the remainder of the contract, second whether there is adequate consideration for the remaining terms of the contract, and third whether the character of the contract is substantially changed by the removal of the provision to the point where it is not the contract upon which the parties agreed.[935]

It is also true that the status of a clause is not solely determined by its location in the contract, e.g., if a clause is not listed as a condition precedent, it may still be a condition precedent and be construed by the court to be so.[936]

There is also a mutual duty of good faith present in all English insurance contracts which can be breached without actual dishonesty,[937] as recklessness and gross negligence can both also result in finding of bad faith.[938] A similar duty of good faith exists in the Vienna Convention on the Law of Treaties. This duty is called *pacta sunt servanda*, and states that obligations resulting from treaties in force are binding and must be performed in good faith.[939] This is simply one example of the many parallels between private contracting and

[935] Byrne v Inntrepreneur Beer Supply Co Ltd [1999] Eu LR 834; see also James E McCabe Ltd v Scottish Courage Ltd [2006] EWHC 538.
[936] Zeus Tradition Marine Ltd v Bell The "Zeus V" [2000] 2 Lloyd's Rep 587, 595 para 25.
[937] Niru Battery Manufacturing Co v Milestone Trading Co Ltd [2004] 1 Lloyd's Rep 344.
[938] Three Rivers District Council v Bank of England (No 3) [2000] 2 WLR 1220 at 192-193 & 196.
[939] VCLT, *supra* note 110, art 26.

international treaty-making between sovereign States. Interpretation is also to be carried out in good faith.[940]

Conclusions

At the conclusion of this chapter, this author would like to take the opportunity to review and endorse the insurance contract recommendations made by Stephen Tucker over twenty years ago that are still relevant today, particularly in light of the analysis conducted in this chapter. 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.[941] Though this thesis has focused largely on issues of space 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. This chapter demonstrates the relevance of that body of law.

Ensuring contract certainty has substantial benefit to both the insurer and the industry as a whole. "Reducing the time required to reword contracts will save costs, increase efficiency and speed of service to the customer, and risk profiles can be better controlled with fewer claims (and therefore lengthy negotiations and legal costs) arising out of uncertainty, lower PI premiums, and satisfied customers, all of which will produce a competitive ad-

[940] *Ibid*, art 31.1.
[941] Tucker, *supra* note 229 at 139.

vantage."[942] In addition to the insurers, it is also the broker's responsibility to provide wording that is at least intelligible.[943] Though, in the absence of a standardized wording, it is not the broker's responsibility to provide a wording service for the insurer.[944]

If insurers are to perform governance functions for the space industry, it is important to understand how the different types of clauses that are used particularly in insurance contracts will frame that governance. Subjectivities, Conditions/Conditions Precedent, and Warranties all set out the obligations of the insured being "governed" by the contract for the purposes of their activities under said contract. The insuring agreements/operative clauses and exclusions set the parameters for what duties the insurers will take on vis-à-vis the insureds. Incentives can be provided through premium discounts (ex., for enhanced protection from collisions), removal of exclusions, or insurance add-ons for adhering to higher standards or practices in the space industry (ex., debris mitigation standards); these will generally be implemented through endorsements or riders. This chapter has provided a technical perspective on an answer to sub-research question three, namely how insurers can govern effectively.

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[942] Henley, *supra* note 218 at 82.
[943] Charman v Gordian Run-Off Ltd [2003] Lloyd's Rep IR 337, para 22; see also Pratt v Aigaion Insurance Co SA (The "Resolute") [2008] Lloyd's Rep IR 610, para 28 (both overturned on other grounds).
[944] GE Reinsurance Corporation v New Hampshire Insurance Company Ltd. [2004] Lloyd's Rep IR 404; Stanton & Stanton, Ltd v Starr (1920) 3 LlL Rep 259.

Chapter 10: Specific Areas in which Insurance can Increase Economic Viability and Environmental Sustainability in Space

Introduction

This chapter provides a focused analysis of a particular area (space debris) in which insurers could add substantial value by increasing standards, and additional discussion regarding space situational awareness and space weather. In order to make normative recommendations for reform, the analysis includes a doctrinal assessment of the particularly relevant areas that have not been covered in detail earlier in this thesis. Additionally, a unique contribution to this field, a case study of the development of standards within the steam boiler insurance industry and its comparison to space law for applicability in this area is included in this chapter, as well. The chapter closes with a brief discussion of other forms of insurance that can be leveraged along with space insurance to reduce premium cost and increase the scope within which an insurer will be able to govern an individual insured. As such, this chapter provides a comprehensive set of answers to all three elements of the research question, albeit with respect to one particular field of space law. This detailed analysis assists in demonstrating the feasibility and applicability of the *insurance as governance for space* model more generally.

Implementing Insurance-Based Governance / Regulation

Space Debris

Context

As more public and private entities have begun launching and utilizing satellites, the problem of space debris has started to move toward the forefront of public consciousness about space. Many people have heard of the Kessler Syndrome that predicts a point of cascading exponential increase in space debris as debris collides, resulting in unusable Earth orbits.[945] As technology improves, it has become progressively easier and less expensive to launch satellites into orbit. Nanosats and smallsats are substantially cheaper to launch than their larger counterparts, and can be used for a variety of operations. In fact, some entities are pursuing a strategy of introducing "swarms" of small satellites for global coverage in lower Earth orbits. In many cases, space debris mitigation efforts are seen as more costly than they are beneficial, in terms of the individual actuarial analysis on each insurance policy. This is not only unfortunate, but also counterintuitive. In order to maintain the safe and sustainable operation of orbital spacecraft (and eventually more frequent missions that will pass through Earth orbit to travel beyond) and maintain reasonable but still profitable insurance premiums, this issue must be addressed.

[945] "The Kessler Effect and How To Stop It" (13 November 2012) online: ESA, (http://www.esa.int/Our_Activities/Space_Engineering_Technology/The_Kessler_Effect_and_how_to_stop_it).

Though the Outer Space Treaty[946] does contain some provisions that are relevant to the issue at hand and the Liability Convention establishes more detailed liability provisions for damage caused by space objects[947] (including space debris, at least space debris that can be identified), there is no international law that binds States regarding the specific issue of debris mitigation or remediation.

As discussed in more detail in Chapter 4, but of particular relevance with regard to the space debris issue, Article I of the Outer Space Treaty, the exploration and use of outer space is to be carried out for the benefit and in the interests of all countries. Article IX of the Outer Space Treaty states that activities in outer space are to be guided by the principle of cooperation and mutual assistance and should be conducted with due regard to the to the corresponding interests of other States. It also provides a mechanism for consultations in the event that one State's activities may harmfully interfere with one (or more) other State's activities. In this light, creation of an unreasonable amount of space debris that could contribute to making outer space more difficult if not eventually impossible to use and explore would clearly run contrary to these principles.

As has been reiterated throughout this thesis, Article VI of this Treaty establishes that States are responsible for providing authorization and continuing supervision for their nationals' activities in space to ensure conformity with the provisions of the Treaty. Therefore, these principles can be extended to all actors in space who are States Parties or nationals of any State Party to this Treaty.

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[946] Outer Space Treaty, *supra* note 16.
[947] Liability Convention, *supra* note 16.

As private entities and some governments are taking on insurance for their satellites, the space debris question is gaining relevance for the insurers providing coverage. Increasing orbital debris will create increasing danger of full or partial loss of an insured satellite. It is worth considering what insurers can do to promote a safer space environment both for their own benefit and the direct benefit of space users.

What is space debris?

The definition of the term "space object" is critical to understanding the mechanisms governing space debris, particularly given that rules regarding State jurisdiction, registration and liability function primarily by reference to this term.[948] Though the Outer Space Treaty uses the term "space object," it does not define it. The Liability Convention is, from a temporal perspective, the first of the space conventions to provide a definition of the term "space object," though the definition is self-referential. Here, the term is defined to include "component parts of a space object as well as its launch vehicle and parts thereof."[949] The Registration Convention utilizes an identical definition.[950]

Following the rule definition *fiat per genus proximum et differentiam specificam*, 'object' is the general term which is modified by 'space;'[951] and in the context of the space trea-

[948] Cheng, Studies, *supra* note 329 at 463.
[949] Liability Convention, *supra* note 16, art I(d); for more discussion of the definition of "space object" see *supra* Chapter 5 (section entitled *The Evolution of the Boundary Question*) and Chapter 6 (section entitled *Safety in Air Law and the Chicago Convention*).
[950] Registration Convention, *supra* note 16.
[951] Gyula Gal, "Space Objects – 'While in Outer Space'" in Proceedings of the International Institute of Space Law (Reston: American Institute of Aeronautics and Astronautics, 1995) 84 at 84.

ties, must also be modified by and include 'its component parts.'[952] With regard to stray items in space, the treaties consistently include component parts as space objects.[953] Therefore, the term "space object" automatically includes component parts unless contextually indicated otherwise.[954] Likewise, payload is "property on board" a space object "forming part of that space object and would not be an independent space object. This would in fact apply to all items of property on board."[955]

The term space object can be abstruse and lead to misinformed interpretations.[956] Despite the attempt at providing a definition of the term, the Liability and Registration Conventions merely provide some insight as to what can be included in the definition, but not what should or could be excluded.

Bin Cheng asks, "[d]oes a space object ever cease to be a space object, and if so, when?...One can probably say that they do not cease to be such until perhaps they have been dismantled or otherwise disposed of[;]"[957] in other words, "[t]here is no apparent time limit."[958] The status of an object as a space object is not affected by its presence in outer space, on a celestial body, or upon return to Earth, as stated in the Outer Space Treaty;[959] and at this point these principles can be considered to be declaratory of the rule existing in general international law.[960]

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952 Csabafi, *supra* note 579 at 11.
953 Cheng, Studies, *supra* note 329 at 500
954 *Ibid*.
955 *Ibid* at 501-502.
956 van Bogaert, *supra* note 405 at 118.
957 Cheng, Studies, *supra* note 329 at 504.
958 *Ibid* at 505.
959 Outer Space Treaty, *supra* note 16 art VIII.
960 Cheng, Studies, *supra* note 329 at 466.

The definition of the term space object "does not make the distinction between functional objects and non-functional objects (debris)."[961] Given the emphasis that is placed on space debris in the current dialogue on the state of the space environment, it is important to understand the meaning of "space debris."

In endeavoring to arrive at a working description of 'debris' one can look at the place or places where it is found, the circumstances under which it came to be situated there, the intent of the launching authority which placed the unitary space object initially into orbit, the physical characteristics of the debris, the adversity resulting to functioning space objects and to the community at large from the presence of the debris, and the range of responses available to the launching authority and to other concerned international legal persons, including other States and international intergovernmental organizations, both universal and regional, as well as consortia of States which anticipate detriment as a result of the existence of the debris.[962]

Cheng also observes, "there is no reason to think that non-functional space objects are no longer space objects. The definition of space object is not related to the object's use or usefulness[,]"[963] however, a "space object can become debris in the event that it becomes non-functional, or is abandoned by the launching authority, or both."[964] Additionally, proposed on-orbit servicing activities created the possibility that otherwise totally non-functional objects could become working satellites again.[965] Therefore, an object can be both a space object and a piece of space debris simultaneously; these definitions are not mutually exclu-

[961] Cocca, *supra* note 408 at 180.
[962] Christol, Space Law, *supra* note 339 at 250.
[963] Cheng, Studies, *supra* note 329 at 339.
[964] Christol, Space Law, *supra* note 339 at 51.
[965] The U.S. government has recognized this possibility, see Holden *supra,* note 25 at 2.

sive. In fact, for liability to be maintained by the Launching State(s), an article of space debris must inherently also be a space object.[966]

Professors Francis Lyall and Paul Larsen likewise maintain that the inclusion of "component parts" and the "launch vehicle and parts thereof" in the provided definitions of space object mean that debris is included within the meaning of the term "space object."[967] There is nothing to suggest that objects such as paint flakes or pieces of fuel tanks would be treated any differently under the space law regime than fully in tact space objects.[968] From a liability perspective, it would be desirable to include all manners of debris in an expansive interpretation of space object and its component parts.[969] The problem, of course, would come in terms of identifying the origin of the paint flake or bolt that has caused damage to another satellite.

Many definitions suggest that control is a significant factor in determining whether or not an object can be categorized as space debris;[970] some other key terms used in the discussion of space debris are: hazardous, dangerous, destructive and unsafe.[971] The functionality (or lack thereof) of a space object, as we have seen, is another important factor used by authors in determining whether an item can be qualified as space debris. One example is as follows: "any man-made Earth-orbiting object which is non-functional with no reasonable ex-

[966] Liability Convention, *supra* note 16 at 3.
[967] Lyall & Larsen, *supra* note 248 at 86.
[968] Cheng, Studies, *supra* note 329 at 506.
[969] Lawrence D. Roberts, "Addressing the Problem of Orbital Space Debris: Combining International Regulatory and Liability Regimes" (1992) 15 BC Int'l & Comp L Rev 51 at 64.
[970] Christopher D. Williams, "Space: The Cluttered Frontier" (1995) 60 J Air L & Comm 1139 at 1151.
[971] James D. Rendleman, "Non-cooperative Space Debris Mitigation" in Proceedings of the International Institute of Space Law (Corrine M. Jorgenson ed., 2010) 299.

pectation of assuming or resuming its intended function or any other function for which it is or can be expected to be authorized, including fragments and parts thereof."[972]

Though one author defines space debris as "natural or human made particles that circle the Earth[,]" using 'orbital debris' as an interchangeable term,[973] this is not a comprehensive approach. For the liability regime to function properly, articles of space debris, like space objects, should not be affected by their presence on a celestial body, nor should their status be altered by their return to Earth. The UN COPUOS Space Debris Mitigation Guidelines likewise define space debris as "all man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere that are non-functional."[974] While the limitation of the definition of debris to Earth orbit and re-entry is sensible for the purposes of these mitigation guidelines, a definition that is viable in the long-term, as exploration and use of celestial bodies is likely to continue, should have the scope to include objects on celestial bodies or in space beyond Earth orbit.

For the purpose of this thesis including for insurance purposes, the following definition can be used: any space object, including parts of a space object, which is non-functional that could pose a threat to the continued safe navigation and use of outer space or a celestial body. It is useful to note that as technology improves, it may be possible for a once non-functional object to be repaired or refueled, causing it to cease being debris.

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[972] Vladimir Kopal, "Some Remarks on Issues Relating to Legal Definitions of 'Space Object', 'Space Debris' and 'Astronaut'" in Proceedings of the International Institute of Space Law (Reston: American Institute of Aeronautics and Astronautics, 1995) 99 at 103.

[973] Robert C. Bird, "Procedural Challenges to Environmental Regulation of Space Debris" (2003) 40 Am Bus LJ 635, at 637.

[974] Official Records of the General Assembly, Sixty-second Session, Supplement No. 20 (A/62/20), Annex.

Why is Space Debris a Problem?

Space debris orbits the Earth with a very high velocity, meaning that it can have substantial destructive kinetic energy if it collides with another space object.[975] More than 20,000 pieces of debris bigger than a softball orbit in low Earth orbit at speeds up to 17,500 miles per hour. There are millions of pieces of debris so small they cannot be tracked or accurately counted, and among those there are 500,000 pieces that are marble sized or larger.[976] At high velocities, even tiny paint flecks can cause substantial damage. Several space shuttle windows have had to be replaced due to damage caused by such paint flecks.

The ability to detect debris in the extremely valuable but remote geostationary orbit is even more limited – objects can only be tracked that are at least nearly a meter large. This is particularly relevant as 95% of insured satellites are located in geostationary orbit.[977] As an additional threat, large debris such as non-functional satellites can drift and block the radiofrequency communications of active satellites, rendering them partially or totally non-functional.[978]

> As of February 2014, the GEO regime contains approximately 1145 large-scale, unclassified, and trackable objects larger than 0.8–1.0 m in effective diameter, 760 of which are uncontrolled derelict objects that actively contribute to longitude-dependent congestion levels across the GEO ring. In addition to this large-scale, catalogued debris population, significant populations of uncatalogued objects at sizes as small as 10–15 cm have been detected in GEO opti-

[975] Molly K. Macauley, "The economics of space debris: Estimating the costs and benefits of debris mitigation" (2015) 115 Acta Astronautica 160 at 160.
[976] Mark Garcia, "Space Debris and Human Spacecraft" (23 September 2013) online: NASA, <http://www.nasa.gov/mission_pages/station/news/orbital_debris.html>.
[977] Hanspeter Schaub et al., "Cost and risk assessment for spacecraft operation decisions caused by the space debris environment " (2015) 113 Acta Astronautica 66 at 68.
[978] International Telecommunication Union Radiocommunication Sector, "Environmental protection of the geostationary-satellite orbit" (2010) Recommendation ITU-R S.1003-2 at 3-4.

> cal observation campaigns, and are hypothesized to be indicative of undetected fragmentation events in this regime.[979]

This situation substantially increases the danger in this high-value orbit and therefore difficulty in providing accurate actuarial calculations for the dangers there. Debris magnifies risk and therefore confounds insurers in calculating coverage prices.

Development of International Standards

At an organizational level, NASA was the pioneer of orbital debris mitigation policies and guidelines in the 1990s. In 1993, the NASA Management Instruction "Policy for Limiting Orbital Debris Generation" was established. Subsequently, in 1995 the NASA Safety Standard "Guidelines and Assessment Procedures for Limiting Orbital Debris" were created as the first detailed mitigation guidelines to be used for NASA missions. In 2001, the U.S. Government established the Orbital Debris Mitigation Standard Practices. The National Space Policies of 2006 and 2010 have both directed implementation of these Practices.[980]

As space debris became a hot issue from the 1990s and 2000s, international efforts were organized to address the problem. Though no binding standards have been adopted, non-binding guidelines exist to help space actors determine appropriate levels of debris mitigation. The Inter-Agency Space Debris Coordination Committee (IADC) is an international

[979] Schaub, *supra* note 977 at 68.
[980] J.-C. Liou and David Jarkey, "Orbital Debris Mitigation Policy and Unique Challenges for Small Satellites" NASA Orbital Debris Program Office, Small Satellite Conference, Logan, Utah, 10 August 2015 at 4.

body made up of national and multinational space agencies to coordinate space debris-related activities. They meet annually in order to work on that year's Action Items.

The IADC Space Debris Mitigation Guidelines were accepted in 2002. A similar set of debris mitigation guidelines based on the IADC guidelines were adopted by COPUOS and subsequently the UN General Assembly in 2007. Though adherence to the IADC guidelines is voluntary, participating States have used these standards in developing domestic standards and nationally binding laws and regulations.[981] Please see Chapter 4 for a more detailed discussion regarding how such soft law guidelines contribute to the development of the body of international space law.

As described in the Introduction to the IADC guidelines, the key common principles espoused in debris mitigation standards, guidelines, and handbooks to this point are:

(1) Preventing on-orbit break-ups;
(2) Removing spacecraft and orbital stages that have reached the end of their mission operations from the useful densely populated orbit regions; and
(3) Limiting the objects released during normal operations.

This document likewise recommends that every project have a feasible Space Debris Mitigation Plan established.[982] The IADC guidelines recommend specific parameters for a grave-

[981] James D. Rendleman & Sarah M. Mountin, "Responsible SSA Cooperation To Mitigate On-orbit Space Debris Risks" (2015) Recent Advances in Space Technologies (10.1109/RAST.2015.7208459) at 2.
[982] IADC Space Debris Mitigation Guidelines, IADC-02-01 (Revision 1, 2007) at 7.

yard orbit for geostationary satellites.[983] With regard to low Earth orbit satellites, the IADC (following substantial scientific study) have recommended that 25 years after the completion of operations is a "reasonable and appropriate lifetime limit."[984]As you may have noticed, the key word here is "recommends" – given that the IADC is not in a position to create binding requirements.

The International Telecommunication Union (ITU) has also made a series of recommendations regarding debris mitigation. Their four key principles are as follows:

(1) that as little debris as possible should be released into the GSO region during the placement of a satellite in orbit;

(2) that every reasonable effort should be made to shorten the lifetime of debris in elliptical transfer orbits with the apogees at or near GSO altitude;

(3) that before complete exhaustion of its propellant, a geostationary satellite at the end of its life should be removed from the GSO region such that under the influence of perturbing forces on its trajectory, it would subsequently remain in an orbit with a perigee no less than 200 km above the geostationary altitude;

(4) that the transfer to the graveyard orbit removal should be carried out with particular caution in order to avoid RF interference with active satellites.[985]

Despite these various efforts, post-mission disposal rates have fallen short of desired results.[986] Additionally, low Earth orbit satellites with a perigee higher than 700km are unlikely to deorbit naturally within the prescribed 25-year timeframe, thus smallsats in these

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[983] *Ibid* at 9.
[984] *Ibid*.
[985] ITU Recommendation, *supra* note 978 at 3.
[986] Rendleman & Mountain, *supra* note 981 at 2.

orbits are particularly problematic.[987] From an insurance perspective, even fragments of those satellites that de-orbit and therefore do not wind up as space debris can re-enter the atmosphere and cause casualties (and, of course, liability) to third parties. In particular, tungsten, titanium, stainless steel, beryllium, and carbon-carbon components may not reach melting point during descent and can cause such difficulties.[988]

How Can Insurance Providers Raise the Bar?

There are a number of ways in which insurers can promote space debris mitigation. These strategies include repurposing solutions that have been proposed for other actors. For example, one author has suggested that "a tax or fee levied on both operators of both launch vehicles and spacecraft to account for their impact on elevating collision risks for (current and future) space fleets" would be one option.[989] Instead of a tax levied by a governmental authority that would likely create a forum shopping race to the bottom for space debris regulation, an insurer or group of insurers could either offer discounts for meeting more stringent debris mitigation requirements, or could require additional premium from those entities not undertaking a sufficiently robust debris mitigation plan. Unlike nationally imposed regimes, insurers can implement their policies across international boundaries, reducing "possibilities

[987] Michael V. Nayak, "Implementation of National Space Policy on US Air Force End of Life Operations and Orbital Debris Mitigation" (2012) American Institute of Astronautics at 2.
[988] *Ibid* at 3.
[989] Macauley, *supra* note 975 at 161.

of debris "leakage" if operators of spacecraft divert their launch and mission control activities to countries without corrective taxes."[990]

Critical elements of debris management are collisional breakup debris, mission-related debris, and end-of-life debris. The diversity of debris creation mechanisms makes accounting for debris a difficult prospect. "Unlike smokestack pollutants, for example, the externality cannot be directly priced to automatically and optimally exploit all the debris reduction strategies. In particular, debris managers cannot observe small debris releases from craft, nor can society credibly commit to penalties for large debris generation when defunct craft may remain in (actively used) orbits for decades or more."[991]

Dealing with these diverse mechanisms requires implementation of multiple solutions, which from a technical perspective can include: orbital maneuvering capability, graveyarding capability, and/or shielding. As discussed by Molly Macauley, orbital maneuvering increases the possibility for a spacecraft to evade observable debris, graveyarding capability removes the satellite from the path of usable satellites through atmospheric burn-up or retirement to an unused orbit, and shielding that reduces damage risk and creation of additional debris in case of a collision. As discussed in the ITU recommendations, graveyarding capability requires monitoring and maintaining sufficient fuel to ensure that there will be capability to move the satellite to the appropriate graveyard orbit or de-orbit path.[992] Additional steps to be taken can include de-energizing batteries, propellant, and other systems and augmenting the satellite to improve the ease of tracking for conjunction assessment.[993] All of these would be document-

[990] *Ibid*.
[991] *Ibid*.
[992] ITU Recommendations, *supra* note 978 at 6.
[993] Rendleman & Mountin, *supra* note 981 at 3.

ed in a project's technical specifications and an insurer with sufficient technical specialization could price a premium accordingly not only with the general risks faced by the design, but also for debris mitigation which, importantly, includes collision avoidance technologies.

As explained in mathematical detail in Molly Macauley's article (cited on prior page), there are means to determine an economic impact of likely debris creation and debris mitigation strategies in order to appropriately price such an endeavor. The U.S. Joint Space Operations Center (JSpOC) provides warning of possible satellite collisions, generally 72 hours in advance, but it is ultimately up to the satellite operator to determine whether or not to perform an avoidance maneuver.[994]

The decision taken involves a cost-benefit analysis, balancing on the one hand a risk of collision and on the other the mission disruption, use of propellant or other resources, and any risks associated with the maneuver. Insurers may be in a position to advise insured satellite operators regarding collision avoidance maneuvers if satellites are equipped in accordance with insurer requirements or recommendations. A centralized unit within a space insurer could be created to provide such a service utilizing both actuarial data and experience from insuring a large number of satellites, for a fee or built into the cost of the policy.
Insurers can also purchase services through the Commercial Space Operations Center (ComSpOC) or other such emerging services for collision avoidance and manage notifications for insureds. ComSpOC offers a "facility that fuses satellite-tracking measurements from a continually growing global network of commercial sensors" generating highly accurate space situational awareness data.[995] As we will see below, there are historical precedents

[994] *Ibid* at 3-4.
[995] "Overview" online: ComSpOC, (https://comspoc.com).

for insurers undertaking such specialized, technical mechanisms in order to ensure the safety and sustainability of the insured industries. Underwriters Laboratories is a safety testing and certification organization that was originally formed by the fire insurance industry.[996]

Case Study: Hartford Steam Boiler Insurance Company

Step back in time to the late 1850s, where steam power had become a regular facet of daily life, though a dangerous one. In the highly competitive boilermaker business, users were resigned to the fact of boiler explosions, assuming them unavoidable (explosions in the U.S. were occurring about once every four days).[997]In the now-competitive and also hazardous launch and satellite industries, the creation of some level of debris has come to be expected, though efforts are being made to mitigate that level. Much like the space industry, the early steam boiler industry had strong ties to the military and participants frequently undertake military contracts.[998]

In 1866, the Hartford Steam Boiler Inspection and Insurance Company (HSB) came into being, on the model of the English entity, the Steam Boiler Assurance Company.[999] HSB was (and still is in 2017) more than just an insurance company, they are "an institution devoted to industrial safety."[1000] Inspections were (and are) the soul of HSB's business model; upon a thorough inspection, a boiler would historically be rated as a first, second, or third-class

[996] Baker & Simon, *supra* note 51 at 8.
[997] Glenn Weaver, The Hartford Steam Boiler Inspection and Insurance Company 1866-1966 (Hartford: Connecticut Printers, 1966) at 6-7.
[998] *Ibid* at 79, 107.
[999] *Ibid* at 7-8
[1000] *Ibid* at 46.

risk. The insured would generally follow the recommendations of their inspector to improve the class of their risk. In fact, their reputation was so positive that state and local authorities would accept HSB inspections in place of governmental ones. In that time period, some U.S. states improved their boiler inspection laws with the assistance of an HSB officer in writing the legislative bill.[1001]

HSB was not only successful (they steadily increased their premiums written from $203,507 in 1880 to $1,148,040 in 1900), but they were able to provide an equitable rate while providing the highest level of service to their insureds.[1002] By definition, an insurer has a pecuniary interest in sustainability of their equipment and the HSB shareholders found that a business could perform these safety and sustainability services at a fair rate and still make a profit.[1003] This author argues, that likewise, space insurers can take an active role in promoting space debris mitigation in a way that is beneficial for the space industry and the insurers as well, by maintaining the sustainable usability of outer space moving forward.

HSB offered a number of special services to their insureds: advice as to construction of boilers, installation of boilers, and use of safety devices, a "shop inspection" service in which they would supervise the beginning-to-installation construction of a boiler, "extended coverage" to cover business interruption and loss of rents, and many others.[1004] In 1930, nine out of ten boilers that were built within the U.S. had been inspected by HSB.[1005] Importantly, HSB developed both the "Hartford Standards" (which were adopted by the American Boiler Man-

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1001 *Ibid* at 26-28.
1002 "The History of Hartford Steam Boiler" online: MunichRe, <http://www.munichre.com/HSB/hsb-history/index.html>; Weaver, *supra* at 997, 42.
1003 Weaver, *supra* note 997 at 28, 52.
1004 *Ibid* at 48-49, 57.
1005 *Ibid* at 49.

ufacturer's association as the "Uniform Steam Boiler Specifications") and the "Hartford Settings" for boiler use.[1006] This is one precedent for an insurer developing standards ahead of governmental standards that substantially improve the safety and sustainability of the industry, and demonstrate the business feasibility of implementing such standards without facing the initial burden of an 'undue' governmental regulatory burden. It is also much easier for an insurer to develop and improve standards than it is for a government to continue to evolve regulations through a complex administrative process. Thus, standards can develop at an insurer level ahead of those developed within governments or intergovernmental organizations.

HSB expanded its business model by using specialists with technical knowledge of their fields; they were able to insure flywheels, pressure vessels, turbines, and internal combustion engines.[1007] In more modern times, HSB provides inspection and insurance services for nuclear power plants in addition to boilers and other such machinery. They also employ "a unique proactive inspection service strategy that helps to identify insureds with equipment that local law or code requires be inspected"[1008] – this is translatable to the space industry in terms of helping insureds avoid regulatory risk with regard to their space technologies. Technical experts in the space field could be utilized in a similar way for mission review and recommendations, as well as the provision of additional services.

HSB, along with six other similar companies, formed the Steam Boiler and Fly-Wheel Service and Inspection Bureau (later the Boiler and Engineering Insurance Service Bureau),

[1006] *Ibid* at 50.
[1007] Weaver, *supra* note 997 at 64-66.
[1008] "Welcome to Hartford Steam Boiler" online: MunichRe, (http://www.munichre.com/HSB/about-hsb/index.html).

an insurance association to regulate standards of inspection.[1009] They also joined with boiler manufacturers and steam users to create the Uniform Boiler and Pressure Vessel Laws Society, which secured the adoption of the American Society of Mechanical Engineers Code by thirty-nine U.S. states as well as a number of other jurisdictions.[1010] An equivalent professional organization could be a logical step in insurer coordination of their governance function in outer space.

Space Debris Wrap-Up

Despite the fact that the research in the area of space debris highly points toward a need for increased mitigation and/or remediation of debris, "[e]ven now, the spacecraft operators and insurance industry do not appear overly concerned with addressing space debris."[1011] Though it is unfortunate, space insurers tend to view space debris as a threat to space traffic management as a risk that is manageable and not imminent. Even though they can appreciate the danger to satellites in both LEO and GEO, the risk to each individual satellite is minimal enough to evade serious consideration.[1012] This is not only unfortunate, but counterintuitive. In order to maintain the safe and sustainable operation of orbital spacecraft (and eventually more frequent missions that will pass through Earth orbit to travel beyond) and maintain reasonable but still profitable insurance premiums, this issue must be addressed. It would be tragic to wait for a serious collision before this problem is given serious consideration.

[1009] Weaver, *supra* note 997 at 69-70.
[1010] *Ibid* at 72-72.
[1011] Schaub, *supra* note 977 at 69.
[1012] Philip A. Slann, "Space Debris and the Need for Space Traffic Control" (2014) 30 Space Pol'y 40 at 41.

Insurers are in a unique position to be able to take additional steps to promote debris mitigation. By employing technical experts within insurance companies, it is possible to implement both additional services and more effective review for implementation of premiums that take into account effective debris mitigation measures (or lack thereof). Perhaps most importantly, insurers are in a position to develop more stringent and specific debris mitigation guidelines, or even requirements, than would possible for political or other reasons at a governmental or intergovernmental level. As has been shown in this paper, there is precedent for such standards being subsequently adopted as regulations within relevant jurisdictions.

Additionally, insurers may be able to procure situational awareness data for their insureds as a group, and provide recommendations to their insureds regarding whether or not to undertake maneuvers from a risk perspective when an SSA provider advises such maneuvers. Ultimately, awareness and exploration of such options is the first step to developing innovative solutions to foster the development of a sustainable space industry. There is an incentive for insurers to promote use of these services to protect their insured assets.[1013]

Space Situational Awareness & Space Weather

If a collision were to occur between two tracked space objects, it would involve the legal, insurance, and foreign relations communities, which all share an interest in better information and technologies for space traffic management; the risks of insufficient space situational awareness capabilities are clear for both satellite operators and providers of space in-

[1013] William Ailor, "Space Traffic Control: A View of the Future" (2002) 18 Space Pol'y 99 at 103.

surance.[1014] The difficulties caused by space weather and technical malfunctions are more heavily noted as potentially significant risks by space insurers.[1015] Though space weather can have a substantial impact on the operational capabilities of satellites, it is often an afterthought to insurers.

> From the space-insurance perspective space weather is currently perceived a low concern with only few claims due to space-weather related damage. An explanation could be that anomalies may not have been claimed, as satellites have redundant systems, or that space weather was not recognised as the root cause of damage. During the severe space weather in 2003 reportedly 45 satellites were affected with 1 science satellite being a total loss. However, no claims were filed with the insurer. Generally, space insurance believes that preparedness levels are low. Satellites may have been designed to resist events of the magnitude of the 1989 and 2003 events but not for the 1921 or the 1859 Carrington event.[1016]

Thus, this section will address the role that insurers can play in both the prediction of and preparedness for space weather incidents. These policies do not exclude damage, for example, from solar activity.[1017]

Some new technologies designed to decrease the cost and difficulty of placing a satellite in orbit actually increase risk from a space traffic management perspective. For example, satellite operators are now implemting efficient, low thrust transfer in order to insert their sat-

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[1014] *Ibid* at 104.
[1015] Slann, *supra* note 1012 at 41.
[1016] Elisabeth Krausmann, "The Space-Weather Awareness Dialogue: Findings and Outlook" online: Clima Espacial, <http://www.climaespacial.net/documentos/ar_11.pdf> at 8. The Carrington event is the largest solar event on record, which caused Northern Lights as far south as Cuba and sparks to be thrown from telegraph equipment casusing fires, if such an event were to happen today, it would be devastating. Events of less magnitude have taken down power grids for a number of hours. Solar Superstorm, online: NASA, <https://science.nasa.gov/science-news/science-at-nasa/2003/23oct_superstorm>.
[1017] Ross, *supra* note 9 at 1089.

ellites into the correct orbit. Because these transfers use low thrust, the slow travel through altitude ranges creates a greater potential for collision or radio frequency interference.[1018] Better tracking data could also help insurers and regulators to verify that operators are conforming to standards and technical plans in their satellite operations.[1019]

Finally, insurers can contribute positively to both better space weather traffic forecasting and preparedness for space traffic weather occurrences in several ways: 1) put in place methods to contribute to a greater understanding of extreme space weather and the impacts of normal and extreme space weather on infrastructure, 2) assist insureds in being prepared to mitigate the effects of a space weather event, and 3) provide data on space weather threats to insureds. Every functioning satellite is subjected to the space environment, which includes solar winds, micrometeoroids, and other forces that can have a negative impact on the operation of a satellite's electronics, solar panels, and other systems.[1020] Effects on space infrastructure can include "electrostatic charging, degradation of electronics and solar-cell damage, memory bit-flips, atmospheric drag that affects the satellite's orbit, loss of stability (star tracking), etc."[1021] Ideally, satellites could be fitted with onboard sensors that could provide data on the space environment to a central data clearinghouse for the purpose of predicting space weather and providing information on current status. Some satellites in GEO are already equipped with sensors intended to measure the satellite's surface charge.[1022] Telemetry data could also contribute positively to this set of information. In terms of preparedness, satellites can be required to maintain maneuvering capability, built-in redundancies in case of

[1018] Ailor, *supra* note 1013 at 100.
[1019] *Ibid* at 101.
[1020] *Ibid*.
[1021] Krausmann, *supra* note 1016 at 4.
[1022] Ailor, *supra* note 1013 at 101; Krausmann, *supra* note 1016 at 4.

space weather damage, and other technical attributes that harden a satellite in case of adverse conditions in the space environment.

Much like with possible conjunction data, insurers could provide guidance to insureds on which steps may be appropriate to take in reaction to an early warning regarding a space weather event. In case of a space weather event warning, lines of communication, responsibilities, and reactions need to be put in place ahead of time.[1023] Insurers could help build this plan with their insureds and build them into policy language.

The interconnectedness between space insurance, space traffic management, and the legal and regulatory aspects of space activities can be very complicated. This chapter has attempted to demonstrate some of the ways in which that is true, and some possible ways this interconnectedness can contribute to solving real problems of space insurance and space traffic management today.

Leveraging Other Forms of Insurance for Space

This section evaluates the viability of other types of non-traditional space insurance with regard to the space industry. Insurance begets more insurance.[1024] The ability for insurers and brokers to bundle different forms of insurance together helps to protect both the insured and themselves – if there is explicit coverage under one policy, there is less likely to be a dispute regarding whether or not the same loss is covered under another policy. This ena-

[1023] Krausmann, *supra* note 1016 at 8.
[1024] Stone, *supra* note 153 at 52.

bles premiums charged for bundled policies to remain lower than purchasing each insurance policy separately.

Likewise, new forms of insurance are not always necessary in order to cover the space industry. Many types of insurance can be applied to the space arena with little modification. Social activists will often attempt to demonstrate that new problems can fit within the existing rubrics for insurance,[1025] space is no different.

One such type of insurance is regulatory defense coverage. Regulatory insurance is a type of insurance, commonly offered in the medical field, which covers fines and penalties levied by regulators. The International Risk Management Institute defines regulatory risk as "The risk that a change in laws and regulation will significantly impact an institution. A change in laws or regulations enacted by a governmental or regulatory body can dramatically increase the costs of conducting a business, decrease the attractiveness of an investment, or change the competitive landscape."[1026] These policies will cover legal defense and penalties incurred in the process of handling a possible regulatory violation. It is easy to see how insurance against this risk could prove valuable to the space industry, with evolving national regulations and the potential that an individual company could be subjected to the regulations of multiple States. Of course, preparedness for regulatory changes and a properly trained legal staff are also tools available to decrease regulatory risk.

Intellectual property insurance protects against allegations of infringement and depending on the coverage provided can also protect the intellectual property rights of the company against potential infringers. This type of insurance typically covers copyright, trade-

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[1025] *Ibid* at 68.
[1026] Regulatory Risk, online: IRMI, <https://www.irmi.com/online/insurance-glossary/terms/r/regulatory-risk.aspx>.

mark, or patent infringement claims. Given the levels of innovation in the space industry and regulations regarding technology transfer, this type of insurance could be very beneficial in the space industry, particularly if bundled with regulatory insurance. There are a number of products available in terms of intellectual property insurance: before the event legal expenses (before the claim is made), opinion only, enforcement and defense, damages, and validity.[1027] This type of insurance can provide a deterrent and improve your negotiating position in case of potential IP disputes; it can also protect your cash flow and possibly enable your IP to be used as a form of collateral.[1028]

Cyber insurance and privacy breach insurance can be valuable to the space industry. Cyber insurance covers a range of both first and third party losses, including loss or destruction of data, network damage, system failure, breach of confidentiality, invasion of privacy, and transmission of computer viruses, for example. Data breach insurance, more specifically, protects against the possibility of data loss. Privacy breach response insurance is a particularly interesting and rapidly expanding field of insurance that has developed in response to regulations that have been promulgated requiring notification and monitoring when data breaches occur. With the vast quantity of data carried by satellites and the increasing likelihood of attacks on such satellites, it is easy to see the potential relevance of a modified form of this insurance in the space arena. Both data breach and cyber are classified within a group of coverages known as technology risk. For example Zurich offers this coverage with "critical infra-

[1027] "Intellectual Property Insurance," online: UK Intellectual Property Office, <https://www.gov.uk/guidance/intellectual-property-insurance>.
[1028] *Ibid*.

structure breakdown" coverage[1029] (often otherwise combined with or known as business interruption insurance). AIG offers a similar package of coverages that also can cover new innovative technologies being employed by a company.[1030]

There is substantial overlap in these areas of insurance in terms of what they cover – a potential insured will need to work with their broker to determine which coverage is most suitable to their individual needs; in many cases, they may simply be different names for the same products.

> The policies cover a variety of expenses associated with data breaches, including: notification costs, credit monitoring, costs to defend claims by state regulators, fines and penalties, and loss resulting from identity theft.
> In addition, the policies cover liability arising from website media content, as well as property exposures from: (a) business interruption, (b) data loss/destruction, (c) computer fraud, (d) funds transfer loss, and (e) cyber extortion.[1031]

The purpose of this form of insurance is to prevent, prepare for, and protect your entity in case of data breach, attempted data breach, or other technological risk.[1032]

Finally, war risk insurance has been an interesting point for the aviation industry and is worth considering here. Since 1968, Lloyd's polices have excluded coverage for "War, Hi-

[1029] Technological Risks: Back to the Future online: Zurich, <https://www.zurich.com/en/knowledge/articles/2015/04/technological-risks-back-to-the-future>.
[1030] Guide to Technology Risk, online: AIG, <https://www.aig.co.uk/content/dam/aig/emea/united-kingdom/documents/strategicrisk-tech-risk-guide-june-2015-brochure.pdf>.
[1031] "Cyber and Privacy Insurance," online: IRMI, <https://www.irmi.com/online/insurance-glossary/terms/c/cyber-and-privacy-insurance.aspx>.
[1032] Cyber Risk, online: Marsh, < https://www.marsh.com/us/services/cyber-risk.html>.

Jacking, and Other Perils."[1033] Prior to 11 September 2001, it was often possible to receive this coverage for no additional premium or at a very low rate, though this has not been the case since then. From 2002 to 2014, the FAA offered Premium War Risk Insurance to the aviation industry as a state-sponsored insurance program, but this program has expired and thus is no longer available through the FAA.[1034] This coverage, now commercially available on the private insurance market, is likely to be a wise purchase for the space industry as it develops and reusable vehicles become more common, for the same reason that it is beneficial for the aviation industry: in the case of hijacking or a terrorist attack, a rocket or even a suborbital horizontal launch vehicle could cause substantial damage. As the industry matures, space insurance for reusable vehicles is likely to and should look more like aviation insurance, which should also include coverage for this type of risk.

Conclusion

Using the example areas of space debris and space situational awareness, there is obvious benefit that the insurance industry could provide by enhancing their incentives for adhering to higher space debris mitigation and collision avoidance measures, which would help to preserve the space environment for the long term to prevent a catastrophic event that might render certain orbits uninsurable. Even without an extreme catastrophe, increasing levels of

[1033] Lloyd's Exclusion Form AVN48B in Tom Chappell, "War Insurance --- Misunderstood and Underappreciated" (2 February 2002) online: AVweb <http://www.avweb.com/news/insure/182771-1.html>.

[1034] Premium War Risk Insurance, online: FAA, <https://www.faa.gov/about/office_org/headquarters_offices/apl/aviation_insurance/ext_coverage/>.

space debris will pose increasing danger to new satellites operating in crowded orbits and will therefore also increase the premium associated with those risks. Insurers hold a prime position to enforce or at least incentivize these actions. The hurdle that must be overcome is the insurer reliance on the low probability of collision for any one individual insured space object (as opposed to the probability of a damaging collision overall).

The comparison to the Hartford Steam Boiler Company and the development of standard for the steam boiler industry that were later adopted by governments provides an obvious model for how such actions can both benefit the industry and create a profitable insurance scheme. Likewise, for a more modern example, in the railroad industry, railroads have flexibility to trade increased safety measures for lower insurance premiums, which will be verified by insurance companies.[1035] This is an example of a less mature version of the process developed by HSB. The studies conducted in this chapter provide viable recommendations answering all three prongs of the research question presented in this thesis: Where are there gaps, can insurers govern, and how can they govern in those gaps?

[1035] Ian Savage, The Economics of Railroad Safety (Dordrecht: Kluwer, 1998) at 133-134.

Chapter 11: Final Conclusions

This Chapter provides a discussion of the recommendations that have emerged as a result of the research and writing contained in this thesis, though individual chapters have offered their own concluding thoughts on their relative, specific subject matters. This thesis has proven that:

1) From a legal and policy perspective, there are regulatory voids that could or should be filled, at least temporarily. There are benefits to be gained from filling such gaps even if such gap-filling does not always rise to the level of a "need."
2) Space insurers are in a position to be able to fill or partially fill that governance void, though they are limited in their effectiveness, primarily by the lack of universal need for or subscription to insurance.
3) Insurers can be aware of the governance role that they are playing and will continue to play regardless of whether or not they acknowledge it. Insurers can take advantage of their technical expertise and transboundary reach to provide guidance and support to their insureds, including by: offering premium discounts for factors that will have the long-term effect of reducing risk for space activities, carefully and attentively drafting language to both fill regulatory gaps and ensure contract certainty, employing precaution in areas where actuarial calculations cannot provide predictable results, bundling services (such as space situational awareness) that will reduce the likelihood of an occurrence, maintaining supervision of their insureds to ensure risk mitigating behavior, and by setting appropriate minimum standards for the insurance they underwrite. As a corollary to this, governments can and should be aware of the governance power exerted by insurers,

and should consider this in legislative and/or regulatory decisions (for example, by essentially inviting insurers to regulate through mandating certain types of insurance coverage).

The concept of governance is broader than the function of governing carried out by governments. In fact, "[g]overnance itself is often defined as government without readily identifiable governors."[1036] For the purposes of this thesis, however, a definition of governance more akin to the one utilized by UNESCO would be more appropriate: "In a broad sense, governance is about the culture and institutional environment in which citizens and stakeholders interact among themselves and participate in public affairs. It is more than the organs of the government."[1037] This thesis exists in the world of institutional pluralism that contributes to a complex system of global governance.[1038]

The ideal scenario will foster efficient cooperation in governance between the State and regulated space insurers. Space insurance is a major factor in the successful growth of the commercial space industry, in terms of both mandatory insurance coverages (like third party liability) and 'optional' forms of insurance that entities may carry to protect their assets and businesses from disaster. For the commercial space industry to continue to grow and move on the path to overtaking public activities as the dominant driver in space, these activities must

[1036] Jan Klabbers & Touko Piiparinen, "Introduction to the Volume" in Normative Pluralism and International Law: Exploring Global Governance, Jan Klabbers and Tuoko Piiparinen, eds (Cambridge: Cambridge University Press, 2014) 1.
[1037] UNESCO, Concept of Governance, online: UNESCO Education <http://www.unesco.org/new/en/education/themes/strengthening-education-systems/quality-framework/technical-notes/concept-of-governance/>.
[1038] Piiparinen, Tuoko, "Exploring the Methodology of Normative Pluralism in the Global Age" in Normative Pluralism and International Law: Exploring Global Governance, Jan Klabbers and Tuoko Piiparinen, eds (Cambridge: Cambridge University Press, 2014) 35.

be both financially and environmentally sustainable in the long term. This thesis has helped to analyze and provide recommendations regarding the role of insurance in both forms of sustainability.

A substantial amount of political decision-making is about managing risks that do not originate from the political arena, but have to be managed within it;[1039] unfortunately, actively managing risk is also a political risk, and thus sometimes leaves the political sphere without the political will to do so. The legal regime that is currently in place is insufficient[1040] to manage the risks to today's spacecraft fleet. One key element of risk management is prevention; using technical control and understanding to measure risks and reduce their probability.[1041] Insurance is so central to all institutions in our modern society that it has become the core and repository of risk communication systems, even those of other institutions.[1042] As a function of human behavior, large and complex risks will require rxperience in the underwriting and contracting process.[1043]

Space activities are highly risky, but also offer a potentially enormous pay-off. "Manufactured uncertainties, global risks are, highly ambivalent, paradoxically also a moment of hope, of unbelievable opportunities—a cosmopolitan moment."[1044] Space activities offer opportunities for the advancement and expansion of humanity, alongside potentials for glory and profit as well. Where there is high risk, there is an opportunity for insurers to take on some of that risk in order to both contribute to their own financial success and also to balance

[1039] Giddens, *supra* note 57 at 5.
[1040] Slann, *supra* note 1012 at 41.
[1041] Ewald, *supra* note 62 at 282.
[1042] Ericson et al, *supra* note 38 at 9.
[1043] Henley, *supra* note 218 at 79.
[1044] Beck 2014, *supra* note 35 at at 88.

the burden such that emerging entities can afford to carry out their activities. These insurers have the actuarial expertise to understand the true costs of these risks and assess them appropriately, where entrepreneurs may be unable to make such determinations regarding the relative actual risk in terms of a given activity or action.

The ability to assess and manage risk is critical to the success of any business venture, particularly one in such a hazardous and extremely visible field as space. Someone must govern the allocation of risk in space, and as we have seen from historical examples in other fields, insurers are well positioned to effectively and efficiently step in as regulators of space. "In practice, the question of who can control a risk is determinative of whether it is insurable and on what terms. The need to determine individual responsibility for risk control is at the heart of moral risk detection and assessment. It turns insurers into agents of governance in all aspects of their operations."[1045] This thesis has provided a solid answer to the second research subquestion regarding the ability of space insurers to fill the role for this industry.[1046]

In replacing state regulation with insurer quasi-regulations (conditions and terms of insuring agreements), it may be possible to avoid political controversy, but Heimer argues that this can come at the cost of promoting narrow regulatory goals that avoid liability for loss rather than broader regulatory goals that may benefit society.[1047] She believes that "government by the insurers for the insurers is not an inspiring alternative to government by the people for the people"[1048] when insurers play a role as extralegal regulators. This author argues, however, that in the space industry in particular, this problem is a less substantial concern.

[1045] Ericson et al, *supra* note 38 at 12.
[1046] See chapters 2, 3, 9, 10 answering research sub-question two.
[1047] Heimer, *supra* note 148 at 123.
[1048] *Ibid*.

When insurers simply "avoid liability for loss" this is known among their customers and does not build a congenial business environment. In a global industry that is as relatively small and tight-knit as space, it is not to the benefit of the insurers to engage in business practices that require customers to pay for insurance coverage and then avoid liability for loss in case of a claim. Additionally, State liability for space activities is more likely to spur government involvement that produces more strict requirements for third party insurance if circumstances are created where those States cannot be indemnified by U.S. space actors due to failure of insurance. Essentially, this could create a once-removed insurance system, whereby insurers are regulated by the State and effectively pass that regulation on to those conducting space activities.

Governments, employers, banks and other institutions require insurance and thus require insureds to follow the insurer's requirements or conditions. Insurance rules suffer from a substantially reduced transparency when compared with State regulation, which often comes after substantial debate, comment, and revision.[1049] "Insurance is a core institution in this risk society. On the one hand, it underwrites the ability to play with danger…On the other hand, insurance is crucial for loss prevention and harm minimization. Through inspections and contract enforcement, it articulates standards of risk management that foster safety and security."[1050] Indeed, the impossibility presented to this author in trying to obtain a single full copy of a launch insurance policy highlight the utter lack of transparency in this specific subsector of the insurance industry, which guards its policy wordings tightly (this is certainly *not* the case on the aviation side). While this lack of transparency is a hurdle to the governance

[1049] Heimer, *supra* note 148 at 128.
[1050] Ericson et al, *supra* note 38 at 8.

structure proposed by this thesis, it does not cancel out the benefits of using insurers as quasi-regulators, particularly given that the proposal is for this to be carried out as an interim measure until government is ready to regulate (much like occurred with regard to steam boiler insurance).

Insurer regulation has the greatest practical impact when powerful actors in an organization work as allies and participate in implementing the general principles of insurance-led regulation in accordance with their particular conditions.[1051] In this circumstance, even though there may be reduced transparency, there can be a great benefit to the industry. In fact, in some ways, reduced transparency can help to foster business growth, as long as the principles being implemented behind the curtain are actuarially and rationally sound.

The era of precaution in which we currently operate demands regulation in one form or another to ensure that proper precaution is taken without stifling development with excessive precaution. Fundamentally, precaution is a principle of responsibility. The problem will be if precaution is viewed so strictly that it prevents action. The balancing of risk and precaution in a technological society is an important process to prevent disaster but also to continue to foster innovation. This concept is intrinsically tied to sustainable development.[1052] The insurance industry serves many of the same purposes as the State in a society that has encouraged downsizing of State governance; its knowledge of risk positions this industry to foster governance.[1053] This combination of factors uniquely places the space insurance industry to fill this governance role.

[1051] Heimer, *supra* note 148 at 153.
[1052] Ewald, *supra* note 62 at 299.
[1053] Ericson et al., *supra* note 38.

In some cases, insurers as private business may be able to operate with more rapid and effective changes that respond to an evolving technological environment than a government actor could. "We have to learn fast that modernity is urgently in need of reflexive market regulations, more than that, of an international constitution to negotiate conflicts over answers to global risks and problems—build on consensus between parties, nations, regulators, friend and foe."[1054] In the interim, global insurers can implement global policies that are responsive to technological change with much more ease than could be achieved through government intervention, with or without international cooperation.

The greatest hurdle to the governance model proposed by this thesis is the lack of universality. At best, third party insurance is required for launch and a small window following launch. Third party insurance does not cover damage caused by a space object when it becomes space debris, with the exception of a limited number of policies specifically underwritten in a small market for that purpose.[1055] That being said, the "options of staying thinly-capitalized and simply resorting to bankruptcy in case of a massive accident do not appeal to many of the new space entrepreneurs given their broader social goals for space activities."[1056] Additionally, those banks providing loans can (and increasingly do) require first party insurance as a means to guarantee their investment,[1057] raising the relative number of insured satellites. Though larger government actors undertaking space activities often do not purchase liability insurance,[1058] this is not universally the case. Soyuz launches, for example, are in-

[1054] Beck 2014, *supra* note 35 at 87.
[1055] Gaubert, *supra* note 229 at 937 & 939.
[1056] Schaefer 2008, *supra* note 247 at 410.
[1057] Gaubert, *supra* note 229 at 930.
[1058] Schaefer 2008, *supra* note 247 at 412.

sured.[1059] Signs point to both an increasing need for and a more frequently exercised option to maintain first party insurance for space activities. While a space insurer-led governance regime is unlikely to ever be truly universal, it is moving in a more uniformly applicable direction. Regardless, though, space insurers *are* acting in a quasi-regulatory capacity with regard to their insureds' activities and it is worth being aware of this fact and managing this role effectively even if the applicability of that governance function were not to expand further.

With regard to space insurance, it is an attorney's job to advise her clients regarding the risks of third party liability and first party damage, which these clients must assume, and how to provide for these risks, as well as their licensing and compliance requirements.[1060] The advice provided will include proper implementation of a complex risk management structure that incorporates contractually assigned responsibilities, insurance contracts, and government indemnification to ensure safe and responsible commercial space activities.[1061] A well informed corporate counsel for a space entity can make informed recommendations and conduct reviews of their client's documentation on the basis of the information provided in this thesis.

Proper drafting is critical to the future of the space insurance industry as wordings evolve and become more standardized as space activities become more routine and the need for inexpensive policies for small ventures grows. It is the responsibility of the insurers to

[1059] Gaubert, *supra* note 229 at 931.
[1060] Nesgos 1989, *supra* note 75 at 23 & 26.
[1061] *Ibid* at 27.

carry out proper drafting.[1062] The insurers have access to legal advice and should have knowledge of the appropriate workings of the space insurance market.[1063] It is the responsibility of each entity's legal counsel to review the drafting of insurance policies and provide that they are modified by endorsement where necessary to meet their client's needs. Attentiveness on this front will not only benefit the insured, but will also provide insurers with consistent opportunities for feedback from the market, so that they may adapt their form of governance as necessary to changing circumstances. Likewise, space insurers and space lawyers alike must take responsibility for the policy and legal role that they play in the industry and place emphasis on sound drafting practices.

Though insurers have been reluctant to impose more stringent requirements for fear of losing market share, there is some indication that reality may be about to change. With thousands of applications on the FCCs docket for unprecedented swarms of new satellites, Christopher Kundstadter, Global Underwriting Manager – Space at XL Catlin and Chairman of the Business/Legal Working Group for the FAA's Commercial Space Transportation Advisory Committee (COMSTAC) has stated:

> Insurers have sort of been playing the game, assuming space is big and nothing is going to hit. But as soon as we have a ten-fold increase in the number of [new satellite] objects ... I think insurers are going to say, OK, this demands a bit more attention. If we're going from insuring 250 objects in space, to insuring 25,000 objects in space, then obviously it becomes a bigger issue. We insure collisions now, but I think we're going to be taking a more focused approach.[1064]

[1062] See, for example, Tektrol Ltd v International Insurance Co of Hanover *supra* note 884, para 8.
[1063] AceCapital Ltd v CMS Enery Corp [2009] Lloyd's Rep IR 414, para 18.
[1064] Insurance Business, Sam Boyer, "Influx of orbital satellites could burst open cosmic insurance sector" online: InsuranceBusinessMag, < http://www.insurancebusinessmag.com/us/news/breaking-news/influx-of-orbital-satellites-could-burst-open-cosmic-insurance-sector-64599.aspx>.

This statement signals that perhaps a new era of space insurance, in which insurers are aware of the role they are playing in the space arena and the critical importance of ensuring the continued viability and sustainability of such activities.

Though governments are ultimately the preferred regulators, with principles of democracy, transparency, and accountability represented, in the interim, governance by insurers can help to foster the growth of the commercial space industry in a sustainable manner. There are only twenty insurers providing insurance for space activities globally;[1065] this is a small enough number that could effectively fulfill a quasi-regulatory function more easily than a larger group would be able. That said, the competition among even this small group for customers (insureds) incentivizes some leniency to retain or expand market share that would not be a problem for a unified regulator.[1066] That said, much like a bank will not offer funds to a financially unsustainable venture, an insurer will not provide coverage for one that is too risky. "Practices of voluntary risk taking may be vulnerable to capture by out of control egos, and become little more than ideologies, but they are also productive of skills, mentalities, and strategies that make new solidarities, communities, and forms of governance possible."[1067]

This author would encourage insurers to see themselves more clearly as regulators in the space industry, and to take actions with this vision in mind to simultaneously protect their own assets and their ability to continue to profit from space in the future. Insurers and space attorneys can familiarize themselves with the gaps in the space law regime with regard to the

[1065] Gaubert, *supra* note 229 at 936.
[1066] "The Intersection of Insurance Markets and Liability Regimes Regarding Third-Parties and Space Flight Participants in Commercial Space Activities" 57th Colloquia on the Laws of Outer Space, International Institute of Space Law (2014) 407.
[1067] Ewald, *supra* note 62 at 202-203.

activities they may be representing or insuring,[1068] and consider mechanisms by which they insurers can effectively "govern" their industry to promote sustainability (both financial and environmental) while ensuring efficiency in their pricing and insurance offerings to support the growth both of the space industry generally and the insurance sector to which they belong.[1069]

[1068] See Chapters 2, 4, 5, 6, 7, 8, 10 answering research sub-question 1.
[1069] See Chapters 3, 6, 8, 9, 10 answering research sub-question 3.

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