out space activities," it fails to identify the person responsible for the registration of space objects, seeing as the term "space activity" includes a plethora of activities. Thus, the ultimate result with regard to the registration of space objects is chaos.

The problem with a multiplicity of jurisdictions also plays a role in this issue. Unlike launching States, there can only be one state of registration under Article VIII of the Outer Space Treaty and Article II of the Registration Convention. Though Article 10(3) of the Model Law, while reinforcing Article II of the Registration Convention, does contemplate the situation of how one determines the state of registry amongst two or more joint launching States, it may only be useful in cases concerning state sponsored space activities. In the case of private space activities, the possibility of achieving such an agreement to determine the state of registry cannot always be expected. Hence, operators may have difficulty in identifying which is the appropriate state for registration. Because space activities involve sensitive technology as well as national security interests, it becomes all the more pertinent for operators to identify the appropriate state that can receive information about their space activities.

In addition to concerns regarding registration, the transfer of space objects under Article 9 poses some practical difficulties. The provision stipulates the requirement of prior authorization by the '*competent authority*;'[45] however, in the cross-border transfer of a space object, it is not clear as to which state's competent authority must issue prior authorization. Would it be from the state of transferor or that of transferee? Clarification on this is absolutely required in the wake of Article 14 of the Model Law, which imposes fines on the transfer of space activities without authorization by the competent authority. Moreover, Article 9 stipulates the conditions laid down under Article 4 are a prerequisite for authorization. This only serves to further confuse the nature of these conditions and additional requirements[46] upon which the initial authorization was granted to the transferor. If those conditions and additional requirements continue, questions would arise as to

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[45] Emphasis added.

[46] Additional requirements may be imposed by the authorizing state under Article 4 (3).

the enforceability of them in the transferee's state in case of cross-border transfers.

It is also pertinent to note here that the Model Law imposes minimum restrictions on the transfer of space activity. Understandably, this approach is used to incentivize the private players to increasingly resort to commercial space activities. However, such an unbridled discretion on transfer may be detrimental to national interests. Due to the significance of certain commercial space ventures in rendering some essential public services or security in the states, the transfer of such space activities to other states might cause serious prejudice to the public in general. Therefore, transfer of space activities needs to be properly weighed and balanced by taking into consideration public and private interests. This is why the UNIDROIT Space Protocol,[47] in the exercise of remedies under its provisions, imposes restrictions on the transfer of satellites contrary to the interests of national security and public services under Articles XXVI and XXVII, respectively.

Transfer of the space object/space activity also brings forward some important questions under the space treaties. As per Article VIII of the Outer Space Treaty, the state of registry shall exercise jurisdiction and control over the space object and the personnel thereof.[48] In the event of transfer of a satellite from the state of registry to another state, the debate arises as to which among the two shall exercise jurisdiction and control after the transfer.[49] This situation would be further complicated in the cases wherein the transferee's state does not fall within the definition of 'launching State' and thereby, is not entitled to register the space object.[50]

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[47] Protocol to the Convention on International Interests in Mobile Equipment on Matters Specific to Space Assets 2012, *available at* http://www.unidroit.org/english/conventions/mobile-equipment/spaceassets-protocol-e.pdf (visited Mar. 27, 2016).

[48] Art. VIII: "A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body."

[49] It is important to note here that the wording of Art. VIII of the Outer Space Treaty, "…*shall retain jurisdiction and control*…" shows that exercise of jurisdiction and control is not only a right but also a duty of the state of registration.

[50] 'State of registry' as defined under Art. I(c) of the Registration Convention is "… a launching State on whose registry space object is carried in accordance with Article II." Therefore, the state of registry must essentially be a launching state.

In addition to the problems in terms of exercise of jurisdiction and control, similar kinds of problems can also be seen in terms of liability of the state(s) after the transfer. Since under the Outer Space Treaty and Liability Convention, the launching State is liable to pay compensation for any damage caused by the space activity, blame attribution between the transferor's state and transferee's state would be a common phenomenon in the cases wherein the damage is caused by the space objects after transfer.

To resolve the conundrum, Article 9 needs to be revised and the foreign player should be asked to enter into a contract with the transferor's state undertaking to adhere to the conditions stipulated in the initial authorization. An alternate method would be to insert a clause for agreement between the transferor's state and transferee's state to authorize the transferee's state to impose new conditions and requirements after the transfer. In such a case, a clear hierarchy of operation of law is created and hence there arises no problem of enforcement of conditions and requirements. This would also help in taking into consideration the national security and public service interests of the transferor's state in cases of cross-border transfer of space activities. Moreover, every transfer of the space object/activity should be made conditional upon the clarifications on jurisdiction and control as well as liability issues arising after the transfer.

VI. LIABILITY, RECOURSE AND INSURANCE

Articles 11 and 12 of the Model Law address the aspects of liability, recourse, and insurance. Though Article 11[51] indirectly recognizes the liability of the launching state(s) under the Liability Convention, it provides the state(s) with the right of recourse against the operator of space activity. It also suggests the possibility of right of recourse be limited to a certain amount. The Commentary stipulates the need for a balance between the objectives of incentivization of the private space actors as well as the public

[51] ILA Model Law, Art. 11. "(1) When XY has paid compensation to third parties for damage caused by a space activity in fulfillment of its international obligations, the Government is entitled to recourse against the operator.
(2) The recourse of the Government against the operator may be limited to a certain amount."

purpose of the state.[52] Towards this, it considers the limitations on liability of private space actors as desirable. Although such a move might be suitable for governments of developed states that are capable of withstanding such residual financial liability, it might not be a just proposition from the perspective of developing countries. Undoubtedly, the developing countries would find difficulty in limiting the liability of the operator, as it would burden their limited state funds. Consequently, the developed states that are in a position to afford such privilege may have an unfair advantage to attract/divert private space investments.

At the 2012 IISL conference, Hamid Kazemi, HadiMahmoudi, and Ali Akbar Golroo presented a paper titled "Towards a new international space liability regime alongside the Liability Convention 1971."[53] The authors argued that a new treaty on private international space law should be modeled on private international air law. Thus, it would always be desirable to shift the liability for the damage caused by the private space activities to the concerned private player under suitable mechanism. Requiring a state to incur the burden of liability, either fully or partially, for private space activities is not appropriate since it would amount to a situation of compromising the public good in order to uplift the private good.[54]

Article 12 of the Model Law requires private space actors to procure insurance up to a certain financial limit.[55] However, this provision is not applicable with respect to governmental space

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[52] Hobe, *supra* note 12, at 594 & 595.

[53] Hamid Kazemi, HadiMahmoudi and Ali Akbar Golroo, *Towards a New International Space Liability Regime Alongside the Liability Convention 1971*, *in*PROCEEDINGS OF THE FIFTY-FIFTH COLLOQUIUM ON THE LAW OF OUTER SPACE 263-73 (2012).

[54] Sandeepa Bhat B. and P. Ishwara Bhat, *Legal Framework of State Responsibility and Liability for Private Space Activities*, *in*SPACE LAW IN THE ERA OF COMMERCIALISATION 131, 146 (Sandeepa Bhat B. ed., 2010).

[55] ILA Model Law, Art. 12. "(1) The operator carrying out a space activity should be insured to cover damage caused to third parties up to the amount of… (to be established by national law).
(2) The obligation of paragraph 1 does not apply when the Government, as such, carries out a space activity.
(3) The authority may waive the obligation to insure when
(a) The operator has sufficient equity capital to cover the amount of his/her liability;
(b) The space activity is not a commercial space activity and is in the public interest.
(4) The details of the content and conditions of the insurance shall be laid down in implementing a decree/regulation to that effect."

activities carried on under sovereign functions. Further, the provision provides for the waiver of the requirement to procure insurance in two specific occasions: (a) when the operator has sufficient equity capital to cover the amount of their liability; and (b) when the space activity is not a commercial space activity and is in the public interest. However, both the conditions of waiver have their own limitations. First, in case of equity capital, what can be done if the equity capital, which is based on the market conditions, depreciates over the period of time is not answered by the provision. Second, neither 'commercial space activity' nor 'public interest' can be defined in precise terms. Though there is an attempt to define 'commercial space activity' in the Model Law,[56] the definition fails to clarify if the 'revenue' or 'profit' mentioned therein is confined to direct monetary benefits or whether it would also extend to other benefits. Thus, the insurance provision needs to be refined to remove these ambiguities.

In addition to the above-discussed concerns in the provisions, the Model Law has also failed to address several issues, which it should have addressed. These issues are presented in the following section of this article.

VI. ISSUES UNADDRESSED IN THE MODEL LAW

A. De-militarization

An important aspect that has not found a place in the Model Law is a provision requiring and mandating private space actors to carry on activities in accordance with the objective of peaceful purposes. Article IV of the Outer Space Treaty prohibits weaponization of outer space, establishment of military bases, installations, and fortifications, testing of weapons, and conduct of military maneuvers on the Moon and other celestial bodies.[57] The pro-

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[56] ILA Model Law, Art. 2. "Commercial space activity: A space activity for the purpose of generating revenue or profit whether conducted by a governmental or by a non-governmental entity."

[57] Outer Space Treaty, Art. IV. "States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner.

The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations

vision also requires the use of the Moon and other celestial bodies exclusively for peaceful purposes. However, the vague wordings of Article IV of the Outer Space Treaty open up several questions concerning the demilitarization of outer space. These questions relate to the determination of the meaning of peaceful purposes, the application of such a norm to outer space, the possibility of testing weapons in outer space, the permissibility of placing conventional weapons in outer space, and so on.[58] Considering the fact that demilitarization has been a crucial element of several General Assembly resolutions, it is imperative that national space legislation must ensure that the peaceful purposes provision is reflected and clarified in it. The added importance of deweaponization mandates a separate provision warranting not only cancellation of licenses, but also penalties for breach.

In 2009, in the Fourth Committee Report dealing with demilitarization, the delegate of Sweden on behalf of the European Union stated "[w]hile additional legally binding multilateral commitments had been proposed against military threats, finding ways of making progress in the short term, and against all types of threats, was essential."[59] The delegate of Pakistan also agreed with this statement.[60] The Cuban delegate stated that "[t]he current space legislation was insufficient to prevent an arms race in space. The World Disarmament Conference, as the only international forum on disarmament, must play the main role in a multilateral agreement on the prevention of an arms race in space, in all forms."[61] Among other notable contributors, the Kazakhstan delegate supported the draft resolution on International Coopera-

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and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the Moon and other celestial bodies shall also not be prohibited."

[58] *See generally* John B. Gantt, *The Concept of "Peaceful Purposes"/"Peaceful Uses" in the Exploration and Use of Outer Space – Some Practical Examples*, *in* Proceedings of Forty-Sixth Colloquium on The Law of Outer Space 107, 107-12 (2004); (*See also* Jonathan Halpern, *Anti-Satellite Weaponry: High Road to Destruction*, 3 B. U. INT'L L. J.167-208 (1985)).

[59] Debating Outer Space Cooperation, Fourth Committee Hears Growing Number of Actors in Outer Space Could Risk Security of Space Assets, Limit Scope of Peaceful Uses (Oct. 21, 2009), *available at* http://www.un.org/press/en/2009/gaspd433.doc.htm.

[60] *Id*.

[61] *Id*.

tion in the Peaceful Uses of Outer Space, prepared by Colombia, Chile, and Mexico.[62] The Chinese representative recalled that China had jointly tabled a draft treaty with the Russian Federation on the prevention of weapons and use of force in outer space.

Although consensus seems to be growing at the international level as to the demilitarization of outer space, in practice it can be observed that it has not been applied. Therefore, national space legislation may try to deal with the situation by imposing an obligation on private players to not get involved in military space activities. Particularly, what is required is the regulation of private military corporations and dual use satellites. In addition, other shortcomings of Article IV of the Outer Space Treaty, including its applicability in outer space, may be resolved through the implementation of national space legislation. The Russian space legislation,[63] for example, has relatively better provisions on demilitarization, which may be useful for incorporation in the Model Law. It essentially prohibits orbiting, deploying, and testing of nuclear weapons and any other kinds of weapons of mass destruction in outer space. Moreover, the use of the Moon and other celestial bodies for military purposes is also forbidden.[64] Though it does not prohibit other military uses of outer space, such military uses are only allowed to be carried out by the Ministry of Defense of the Russian Federation.[65] Hence, private space actors are not permitted to be involved in any military space activity under the laws of Russian Federation.

B. Property Rights and Resource Exploitation

The Model Law is silent on the issue of private property rights in outer space. While the non-appropriation principle is one of the fundamental principles of the Outer Space Treaty,[66] questions have been raised regarding its applicability to private space actors. One of the major contentions of the asserters of celestial

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[62] *Id*.

[63] Law of Russian Federation "About Space Activity," Decree No. 5663-1 of the Russian House of Soviets.

[64] *Id*., Art. 4 (2).

[65] *Id*., Art. 7.

[66] Outer Space Treaty, Art. II. "Outer space including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."

property rights is that there is only a prohibition on 'national appropriation,' but the right of the individuals to claim property rights is not restricted by such a provision.[67] Though Article 11(3) of the Moon Agreement places an embargo on private property rights,[68] the Moon Agreement has limited application due to ratification by very few states.[69] Based on these arguments, which are against the spirit of the space treaties, several individuals have asserted their claims on the Moon and other celestial bodies, as well as started selling the parts of them.[70]

Though the international community condemns such claims, instances are growing in the absence of appropriate legal actions. Therefore, there is a growing opinion on the requirement of dealing this problem at the national level by the States.[71] In this regard, the Board of Directors of International Institute of Space Law has issued a statement in 2004, which reads as follows:

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[67] Alan Wasser and Douglas Jobes, *Space Settlements, Property Rights, and International Law: Could a Lunar Settlement Claim the Lunar Real Estate it Needs to Survive?*, 73 J. AIR L. & COM. 37, 49 & 50 (2008).

[68] "Neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become property of any State, international intergovernmental or nongovernmental organization, national organization or nongovernmental entity or of any natural person. The placement of personnel, space vehicles, equipment, facilities, stations and installations on or below the surface of the moon, including structures connected with its surface or subsurface, shall not create a right of ownership over the surface or the subsurface of the moon or any areas thereof."

[69] Only seventeen States have ratified the Moon Agreement. *See* Committee on the Peaceful Uses of Outer Space, Status of International Agreements relating to activities in outer space as at 1 January 2017 (Mar. 23, 2017), *available at* http://www.unoosa.org/documents/pdf/spacelaw/treatystatus/AC105_C2_2017_CRP07E.pdf.

[70] Reference can be made to Dennis Hope's business of selling the parts of the Moon and other celestial bodies as well as to the claims made by Gregory Nemitz and Sylvio Langevin. *See*<www.lunarembassy.com> and <http://www.duhaime.org/LawFun/LawArticle-1613/Quebec-Man-Claims-Solar-System-Loses-in-Court.aspx>*See also Nemitz*v. *United States* 2004 WL 3167042.

[71] Prof. Frans von der Dunk, for example, has criticized the business of Dennis Hope, and insisted for appropriate action in the municipal level. He states that "Whether that means it's [the sale of extra-terrestrial property] fraud and such a claim is null and void under national law, would basically be up to any national legal system to determine. It does mean, however, that under international law the U.S. government should unequivocally make clear that these practices are not based on any sound legal premise." (*See* Robert Roy Britt, *Lunar land Grab – Celestial Real Estate Sales Soar*, *at* http://www.rense.com/general48/sour.htm (visited Apr. 1, 2016)); (*See also*Virgiliu Pop, Who Owns the Moon? 18 (2008)).

> …to comply with their obligations under Articles II and VI of the Outer Space Treaty, States Parties are under a duty to ensure that, in their legal systems, transactions regarding claims to property rights to the Moon and other celestial bodies or parts thereof, have no legal significance or recognised legal effect.[72]

In light of the above excerpt, it is necessary to have a provision in the Model Law prohibiting the claim of property rights in outer space and on celestial bodies. In the absence of such a provision, we will witness a lateral expansion of conflicting property claims in the near future. In addition, the Model Law is silent on the related issue of resource exploitation in outer space. This issue is equally important to address, as many commercial space operations in the near future will be directed towards the exploitation of valuable space resources.[73] Conflicts are bound to occur in the absence of legal regulation of exploitation.[74] The Model Law needs to incorporate modalities for authorizing resource exploitation based on established principles of sustainable development and also provide clarity concerning the entitlements of private space actors to the bounties of nature.

C. Emergency Assistance

The Rescue Agreement sets the international norms on emergency assistance in case of space accidents. However, it does not provide detailed procedure on the discharging of obligations in furtherance of emergency assistance. Hence, it is important for national space legislation to detail emergency assistance procedures. In addition, there is some confusion arising from the interpretation of the Rescue Agreement, which was drafted in the era

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[72] *See*'Statement by the Board of Directors of the International Institute of Space Law on Claims to Property Rights Regarding The Moon and Other Celestial Bodies', *at* http://www.iislweb.org/docs/IISL_Outer_Space_Treaty_Statement.pdf (visited Apr. 1, 2016).

[73] Helium – 3 is predicted to be one of the major resources for future exploitation, which is available in abundance on the Moon. Richard B. Bilder, *A Legal regime for the Mining of Helium-3 on the Moon: U.S. Policy Options*, 33 FORDHAM INT'L L. J. 243 (2010).

[74] Fabio Tronchetti, *The Moon Agreement in the 21st Century: Addressing its Potential Role in the Era of Commercial Exploitation of the Natural Resources of the Moon and Other Celestial Bodies*, 36 J.SPACE L. 489, 515 (2010).

of state-oriented space activities, and therefore, is unsuitable to the present era of private commercial space activities. One of the major problems is the absolute obligation under the Rescue Agreement on the state of unintended landing to search and rescue the space object's personnel without any guarantee for expense reimbursement.[75] This obligation stems from the principle regarding astronauts as envoys of mankind stipulated under Article V of the Outer Space Treaty. However, in the present era of commercialization, manned space missions are primarily for furthering individual commercial interests, and not associated with the common interests of mankind. Hence, in cases where personnel on board a private space object are stranded as a result of an unintended landing, it is the private space actor who should bear the costs of rescue.

In the case of space objects, the obligation of the state of unintended landing to recover the space object or its component parts is contingent upon a request from the launching State.[76] In the event of recovery, the recovering state may seek to have its recovery costs reimbursed from the private space actor or the state that launched the space object under Article 5(5) of the Rescue Agreement.[77] Furthermore, without clarity as to the rights and obligations arising out of Article 5 of the Rescue Agreement, problems may also arise with the transfer of space objects. This can be better illustrated with an example: private space actor 'A' operating in State 'X,' which is the state of launching and registry, transfers its satellite to another actor 'B' in State 'Y.' Presumably, State 'Y' is not connected to the launch of the satellite in any manner. Subsequent to the transfer, the satellite makes an unintended landing in the territory of State 'Z.' Under the Rescue Agreement, State Z would be mandated to recover the satellite only at the re-

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[75] Rescue Agreement, Art. 2 states "If, owing to accident, distress, emergency or unintended landing, the personnel of a spacecraft land in territory under the jurisdiction of a Contracting Party, it shall immediately take all possible steps to rescue them and render them all necessary assistance."

[76] *Id*, Art. 5(2) states "Each Contracting Party having jurisdiction over the territory on which a space object or its component parts has been discovered shall, upon the request of the launching authority and with assistance from that authority if requested, take such steps as it finds practicable to recover the object or component parts."

[77] Id, Art. 5(5) states "Expenses incurred in fulfilling obligations to recover and return a space object or its component parts under paragraphs 2 and 3 of this article shall be borne by the launching authority."

quest of State X, the sole launching State in this example. As State Y is not the launching State, it would mean that private space actor 'B' would essentially be left with no remedy. This is because the Rescue Agreement mandates the launching authority (in this case State 'X') to bear the cost of recovery. However, as the interest in the satellite has been transferred from State 'X' to State 'Y,' the former would have no interest in claiming the satellite. Thus, the private space actor 'B' is essentially left at the mercy of State 'X' for recovery of its satellite. This major concern in the treaties needs to be addressed through an appropriate provision in national space legislation that mandates search and rescue—as can be seen in Korean space legislation.[78]

D. Other Incidental Issues

In addition to the three issues discussed above, there are several desirable aspects that could yet be included in the Model Law. First, the Model Law requires norms to regulate space tourism. With space tourism being the next fascination of human beings, states cannot ignore the manifold issues arising out of space tourism, which are different from that of other commercial space activities.[79] Norms need to be incorporated in national space legislation regarding issues such as special authorization, supervision, emergency assistance, codes of conduct for tourists in outer space, environmental protection, etc. Informed consent and safety standards are the two of the most important aspects to be delved into in detail in respect of space tourism.

Second, in the wake of UNIDROIT's[80] failure to develop a separate regime on space financing,[81] it is desirable for the Model

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[78] Korean space legislation mandates the rescue and recovery of both personnel and space objects in case of emergency landing. Arts. 22 and 23 of the Space Development Promotion Act 2005 of the Republic of Korea deal with the obligations to return the personnel and space object respectively.

[79] *See generally* Stephan Hobe, *Legal Aspects of Space Tourism*, 86(2) NEB. L. REV. 439-58 (2007).

[80] International Institute for Unification of Private Law (UNIDROIT) is established with the objective of harmonizing and coordinating private laws, especially commercial laws, of different states to achieve uniformity. *See* http://www.unidroit.org/about-unidroit/overview (visited, Apr. 8, 2016).

[81] UNIDROIT has developed a two-tier system to govern private space financing in the form of Convention on International Interests in Mobile Equipment 2001 (2307 U.N.T.S. 285) and Protocol to the Convention on International Interests in Mobile

Law to address the significant aspects of space financing. Currently, private investors in space activities face a dilemma with respect to a plethora of issues, such as: jurisdiction and applicable law, recognition of their interest under the applicable law, applicable rule of priority in the return of investments, status of return of their investments during insolvency of debtors, etc. Such an atmosphere is not conducive to the growth of beneficial private space ventures, an activity requiring huge investments.[82] Therefore, it is significant for a state that intends to promote commercial space activities to build the confidence of creditors in space investments via national space legislation.

Finally, the intellectual property regime in outer space, especially relating to inventions, needs clarification. Investors in research and potential intellectual property in space, which has become possible with the establishment of the International Space Station,[83] would essentially search for a much anticipated patent protection in space. However, there is no international intellectual property law to grant such protection. More importantly, there is no separate law to deal with the infringement of patented inventions in outer space.[84] Hence, it is up to the states to clarify the increasing number of issues relating to space inventions to prevent the dearth of investments in space inventions. Incorporating the provisions in the Model Law to set standards in this regard is significant for the purpose of establishing uniformity.

VIII. CONCLUSION

One cannot disagree with the fact that the Model Law for national space legislation is a commendable work by the scholars who took part in drafting it. It certainly stands as a positive con-

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Equipment on Matters Specific to Space Assets 2012. However, the system has failed to come into force due to disagreement of private investors. Anjanette H. Raymond and Abbey Stemler, *When Baby Steps Just Won't Work: Small Farmers are our Best Hope Reducing Food Insecurity and we are not Doing Enough*, 35(2) NW. J. INT'L L. & BUS. 335, 358 (2015).

[82] *See* Mark J. Sundahl, The Cape Town Convention: Its Application To Space Assets And Relation To The Law of Outer Space 6 (2013).

[83] It is a joint venture of United States, Russia, Canada, Japan and European Space Agency. *See for details* https://www.nasa.gov/mission_pages/station/main/index.html (visited, Apr. 8, 2016).

[84] Sandeepa Bhat B., *Inventions in Outer Space: Need for Reconsideration of the Patent Regime*, 36(1) J. SPACE L. 1, 6 & 10 (2010).

tribution of the twenty-first century towards the regulation of commercial space activities. However, the authors are of the view that there is sufficient scope for fine-tuning the Model Law to suit the present day requirements of the developed and the developing world alike. The shift from state-oriented space activities to private sector-oriented space activities require a move from traditional space treaty provisions to tailor-made national space legislation in order to deal with the challenges of private space activities. The Model Law fails to adopt such a change within this mindset, which is reflected in the fact that emerging concerns like space tourism, space financing, and space inventions, amongst others, have not found any place in it.

It is understandable that everything cannot be covered by one national space legislation. Hence, supplementary norms need to be developed in the form of rules and regulations over a period of time in correlation with growing experience in the field of private space activities. But this should not be a reason for refraining from experimentation with new methods of addressing emerging concerns that have already come to the forefront. Because space technology is developing at a rapid speed, and consequently, the nature of space activities is changing, we have little time to lag behind in adopting suitable norms. Hence, expanding the horizons of space law at the national level is not only desirable, but also necessary so we need not repent for our present failure in the future.

LEGAL AND REGULATORY CHALLENGES TO LEVERAGING INSURANCE FOR COMMERCIAL SPACE

Andrea J. Harrington[*]

I. OVERALL CONSIDERATIONS

A. Introduction

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

B. Types of Insurance

i. Liability Insurance

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

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

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

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

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

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

[12] *Id.* at 286.

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

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

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

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[13] *Id.* at 287.

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

[15] *Id.* at 477.

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

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

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

ii. Insurance Phases

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

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

C. The Impact of Export Controls

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

[31] 22 C.F.R. § 120.17 (2016).

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

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

D. State Liability

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

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[32] 22 C.F.R. § 120.1 (2014).

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

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

[35] *Id*.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

[49] *Id.* at 15.

[50] *Id.*

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

> In the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State, the latter shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible.

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

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

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

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

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

[55] *Id*, art III.

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

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

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

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[57] *Id.*

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

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

[60] *Id.* at 5.

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

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

[63] *Id.* at 148.

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

E. U.S. Liability & Waivers

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

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

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

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

[67] 51 U.S.C. § 50901 (2015).

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

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

[70] 51 U.S.C. §§ 50914-50915 (2015).

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

[82] *I*d. at 157.

[83] *Id.* at 158.

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

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

II. SPECIFIC CONSIDERATIONS FOR SUBORBITAL AND HYPERSONIC VEHICLES

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

> There is a consensus among operators, brokers and the insurance markets that maiden flights will be uninsurable and that premiums will remain very high until commercial spacecrafts produce 5 to 15 flights without accident. At this point only the amount of data available to underwriters will allow an adequate assessment of the reliability of the vehicles…[99]

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

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

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

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

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

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

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

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[103] *Id.* at 1635.

[104] *Id.* at 1634.

[105] *Id.* at 1635.

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

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

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

B. Liability in Air Law

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

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

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

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

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

[111] *Id.*

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

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

[114] *Id.* art 21.

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

[116] *Id.*

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

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

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

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[117] *Id.*

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

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

[119] *Id.*

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

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

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

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