Minnesota Journal of Law, Science & Technology

Volume 20 | Issue 1 Article 12

8-7-2019

License to Launch: The Regulatory Future of Commercial Ballistic Travel

Jacob Weindling

Note

License to Launch: The Regulatory Future of Commercial Ballistic Travel

*Jacob Weindling**

INTRODUCTION

On a floating platform in the East China Sea off the coast of Shanghai, a tower stands silently in the twilight. A distant boom and, moments later, a gout of flame heralds the descent through the evening clouds of a large, tapered cone. Standing taller than the tower, the now-inert cylinder rocks gently in time with the platform on the chop, having rested less than an hour previously on a similar platform off the coast of Staten Island in New York. Human occupants who boarded this sleek skyscraper halfway around the world now disembark and board a ferry to immigration, having completed a traditional long-haul international journey in one-fifteenth of the time for a direct international airplane flight.

International commercial travel by rocket, a futuristic fantasy that has existed in the public mindset for decades, is fast becoming seriously plausible thanks to key developments in the technology and business arenas. However, ballistic rocket technology, in general, and space-launch vehicle technology, specifically, are currently regulated by the United States as munitions, creating unique regulatory challenges that must be addressed before international commercial rocket travel can truly take off.

This note will examine the current state of both national and international regulatory schemes of consequence to prospective international rocket travel. The background section

* Jacob Weindling is a 3L at the University of Minnesota Law School, where he has studied litigation, business, and technology law. He has a background in theater, vocal performance, and business immigration, and holds a B.A. in Physics from Macalester College.

examines the history of rocket flight and relevant space travel in both the governmental and commercial sectors, as well as the historical development of the regulatory regime surrounding the relevant technologies. This note will then consider the consequences of imposing existing rocketry regulations on today's evolving spaceflight industry, and will provide policy recommendations and options for modifying those regulations to balance legitimate safety concerns with incentives for the responsible development of a valuable new means of transportation. This note concludes that a new international regulatory framework is sorely needed for the sustained development of international rocket travel on a commercial scale.

I. BACKGROUND

In order to fully understand and address the regulatory issues facing the emerging industry of commercial rocket-propelled travel, consideration must be given to the history of rocket technology. This background section will do so, with a focus on three distinct topics: (1) the history of rocket technology and the development of ballistics; (2) the application of rocketry to manned spaceflight through programs administered by various countries in the 20th century and private entities in the 21st; and (3) the formulation of international and U.S. regulations and standards for rocketry technology.

A. HISTORY OF ROCKETRY AND BALLISTIC TECHNOLOGY

A rocket is commonly defined as a jet engine that carries its own combustion fuel.[1] Rockets burning solid fuel such as

---

1. The complete definition of rocket is: "[A] jet engine that . . . consists essentially of a combustion chamber and an exhaust nozzle, carries either liquid or solid propellants which provide the fuel and oxygen needed for combustion and thus make the engine independent of the oxygen of the air, and is used especially for the propulsion of a missile (such as a bomb or shell) or a vehicle (such as an airplane)." *Rocket*, MERRIAM-WEBSTER, https://www.merriam-webster.com/dictionary/rocket (last visited Nov. 16, 2018). Distinct from ballistic rockets are cruise missiles, which operate more closely in design to airplanes. Where ballistic missiles derive the vast majority of their flight power from the direct propulsion of a jet engine or engines, cruise missiles derive their flight power from "the use of aerodynamic lift over most of [their] flight." Intermediate-Range Nuclear Forces Treaty, U.S.-USSR, Between the United States of America and the Union of Soviet Socialist Republics on the Elimination of their Intermediate-Range and Shorter-Range Missiles art. II , ¶ 2, Dec. 8, 1987, 27 I.L.M 90.

saltpeter or gunpowder have been used for well over a millennium.[2] Early rockets had applications both as fireworks and as weapons.[3] It was not until shortly before the advent of the 20th century that the first known rocket was developed, which produced thrust by combining and igniting liquid propellants.[4] From 1915 to 1941, Robert Hutchings Goddard largely invented the rocket motor and liquid propulsion.[5] The development of large rockets for the delivery of munitions beyond the horizon on a ballistic trajectory followed,[6] and on October 4, 1957, the Soviet Union ("U.S.S.R.") used a powerful rocket to place the first manmade object in orbit, Sputnik I.[7] Intercontinental ballistic missile designs were rapidly repurposed for the development of manned missions to space,[8] and the first human orbited the Earth on April 12, 1961.[9]

B. MANNED SPACEFLIGHT OPERATORS

To date, only the governments of the People's Republic of China ("PRC"), the United States, and the former U.S.S.R. have delivered humans to Earth orbit.[10] Currently, the PRC and the Russian Federation are the two entities with space launch vehicles ("SLVs") currently in service with the proven capability

---

2. *See* WERNER VON BRAUN & FREDERICK I. ORDWAY III, HISTORY OF ROCKETRY & SPACE TRAVEL 23 (Thomas Y. Crowell Co.,1966).

3. *See id* at 23–35 (summarizing the evolution of use of explosives in countries across the world).

4. *See id.* at 35.

5. *See id.* at 48–52. The Russians were also conducting their own liquid-propelled rocket development during the early and mid 1930's. *See id.* at 62. Nazi Germany performed some rocket development as well, and notably experimented with a rocket-powered aircraft. *See id.* at 74.

6. *See, e.g., id* at 86.

7. *See id.* at 158.

8. *See id.* at 163.

9. See *id.* at 205.

10. *See* Jim Yardley, *China Sends a Man Into Orbit, Entering the U.S.-Russian Club*, N.Y. TIMES (Oct. 15, 2003), http://www.nytimes.com/2003/10/15/world/china-sends-a-man-into-orbit-entering-the-us-russian-club.html. India, while aggressively pursuing its own space program, is unlikely to attempt a manned mission within the coming decade. Jalees Andrabi & Dean Nelson, *India Takes Giant Step to Manned Space Mission*, THE TELEGRAPH (Dec. 19, 2014), https://www.telegraph.co.uk/news/worldnews/asia/india/11305062/India-takes-giant-step-to-manned-space-mission.html.

of delivering humans to space;[11] The United States lost its ability to send humans to orbit upon the retirement of the space shuttle,[12] and the replacement Space Launch System is not expected to enter manned service until the 2020s at the earliest.[13] Furthermore, only one private organization has ever delivered a human as far as the edge of space.[14] However, the landscape is rapidly evolving – today, multiple private organizations are racing to provide commercial service to space for human passengers.

Since its inception in 2002, SpaceX has brought two rockets to market for commercial space launches.[15] While the introduction of these rockets was not in and of itself a revolutionary innovation,[16] in 2015, SpaceX completed the development and successful fielding of reusable first stage rockets.[17] This modified design of the Falcon 9 rocket first stage

---

11. *See* Marina Koren, *China's Growing Ambitions in Space*, THE ATLANTIC (Jan. 23, 2017), https://www.theatlantic.com/science/archive/2017/01/china-space/497846/.

12. *See* Kenneth Chang, *The Shuttle Ends Its Final Voyage and an Era in Space*, N.Y. TIMES (July 21, 2011), http://www.nytimes.com/2011/07/22/science/space/22space-shuttle-atlantis.html.

13. *See* Kenneth Chang, *Trump Announces That the Moon is Astronauts' Next Destination*, N.Y. TIMES (Dec. 11, 2017), https://www.nytimes.com/2017/12/11/science/trump-moon-space-directive.html.

14. *See* John Schwartz, *Private Rocket Ship Visits Space Again to Win $10 Million Prize*, N.Y. TIMES (Oct. 4, 2004), http://www.nytimes.com/2004/10/04/technology/private-rocket-ship-visits-space-again-to-win-10-million-prize.html. This private spaceship became the design inspiration for Virgin Galactic's SpaceShipTwo currently under development. *Infra* note 29.

15. *See About SpaceX*, SPACEX, http://www.spacex.com/about/capabilities (last visited Nov. 7, 2018). SpaceX is a private company founded by Elon Musk in 2002 with the goal of providing launch services for private and government entities, a goal that has been largely fulfilled. *Id.*

16. *See*, *e.g.*, Sam Hodgson, *How to Cover Rocket Blastoffs With an iPhone*, N.Y. TIMES (Nov. 22, 2017), https://www.nytimes.com/2017/11/22/technology/personaltech/rocket-launches-space-iphone.html (quoting a commentator who noted that SpaceX's initial innovation was offering pre-existing space launch services at a lower price, essentially making it the "Southwest Airlines of rocketry").

17. *See Falcon9,* SPACEX, https://www.spacex.com/falcon9 (last visited Nov. 7, 2018); *see also* Kenneth Chang, *SpaceX Rocket Sticks Landing on the 5th Try*, N.Y. TIMES (April 8, 2016), https://www.nytimes.com/2016/04/09/science/on-fifth-try-mission-accomplished-for-spacex-booster-rocket.html (reporting SpaceX's second time successfully landing a booster stage).

retains a reserve amount of propellant to fly back to the launch pad or a secondary landing site after boosting a payload to the edge of space.[18] By flying recycled rockets, SpaceX may be able to significantly reduce the price of launching rockets into space.[19] Beyond significantly lowering the cost of spaceflight, SpaceX's next recycled rocket, the Starship, also paves the way for a potential sub-orbital point-to-point ("PTP") commercial rocket flight service.[20]

SpaceX has completed and successfully tested a heavy-lift rocket,[21] and is currently developing a habitable capsule for carrying human occupants.[22] These space launch technologies provide the foundation for an intercontinental human transportation service with flight durations theoretically below an hour between any two locations on Earth.[23] In SpaceX's concept, a heavy-lift rocket first stage would boost a second-stage passenger rocket to a suborbital trajectory. Upon separation, the first stage would fly back to the launch site, while the second stage would land at the destination launchpad and be loaded onto another first-stage rocket for reuse.[24] SpaceX CEO Elon

---

18. *See* Kenneth Chang, *Recycled Rockets Could Drop Costs, Speed Space Travel*, N.Y. TIMES (March 30, 2017), https://www.nytimes.com/2017/03/30/science/space-x-reuseable-rockets-launch.html.

19. *See id.* Elon Musk has compared the traditional method of rocketry, in which spent rocket stages fall back to earth, and crash into the ocean to sink, with the notion of throwing away a 747 after each flight, which would make long-distance commercial rocket travel prohibitively expensive. *Id*.

20. *See* Richard Lawler, *Elon Musk Proposes Using SpaceX's 'BFR' to Travel Around Earth*, ENGADGET (Sept. 29, 2017), https://www.engadget.com/2017/09/29/elon-musk-spacex-bfr-travel-earth/. The BFR has since been renamed Starship. *See* Mike Wall, *No More BFR: SpaceX Changing Name of Mars-Colonizing Rocket, Spaceship*, SPACE.COM (Nov. 20, 2018), https://www.space.com/42499-spacex-bfr-mars-spaceship-name-change.html.

21. Kenneth Chang, *Falcon Heavy, in a Roar of Thunder, Carries SpaceX's Ambitions into Orbit*, N.Y. TIMES (Feb. 6, 2018), https://www.nytimes.com/2018/02/06/science/falcon-heavy-spacex-launch.html.

22. *See Dragon Version 2: SpaceX's Next Generation Manned Spacecraft*, SPACEX, (May 30, 2014) http://www.spacex.com/news/2014/05/30/dragon-v2-spacexs-next-generation-manned-spacecraft. This capsule follows SpaceX's Dragon capsule that has delivered supplies to the International Space Station and returned cargo to Earth. *Dragon*, SPACEX, http://www.spacex.com/dragon (last visited Nov. 16, 2018).

23. *See* Lawler, *supra* note 20.

24. SpaceX, *Becoming a Multiplanet Species*, YOUTUBE (Sept. 29. 2017), https://youtu.be/tdUX3ypDVwI.

Musk has claimed that this service will eventually be competitively priced with conventional long-haul airline flights.[25]

Two other organizations are also making meaningful strides toward human spaceflight. Blue Origin, a spaceflight company founded by Amazon CEO Jeff Bezos, is developing both a suborbital launch system[26] and an orbital launch system.[27] The former SLV is billed as a means to provide human passengers with a flight to space,[28] and could also conceivably be utilized for international travel. Virgin Galactic, meanwhile, has been developing a suborbital spaceplane for commercial flights,[29] based on the design of the first non-governmental vehicle to take a human to space.[30] While a test flight of Virgin's SpaceShipTwo resulted in the death of a copilot in 2014,[31] the company has since resumed test flights[32] and recently received a $1 billion investment from Saudi Arabia.[33]

While neither SpaceX, Blue Origin, Virgin Galactic, nor any other organization has yet brought commercial SLV travel to market for international or orbital destinations, the prospect of customers boarding rockets instead of airplanes is clearly taken

---

25. *See* Justin Bachman, *How Crazy Is Elon Musk's Hypersonic Rocket Airline?* BLOOMBERG (Nov. 17, 2018, 9:32 PM), https://www.bloomberg.com/news/articles/2017-09-29/how-crazy-is-elon-musk-s-hypersonic-space-rocket-airline.

26. *See New Shepard*, BLUE ORIGIN, https://www.blueorigin.com/new-shepard (last visited Nov. 17, 2018).

27. *See New Glenn*, BLUE ORIGIN, https://www.blueorigin.com/new-glenn (last visited Nov. 17, 2018).

28. *See* BLUE ORIGIN, *supra* note 26.

29. *See Our Vehicles*, VIRGIN GALACTIC, http://www.virgingalactic.com/human-spaceflight/our-vehicles/ (last visited Oct. 10, 2017).

30. *See* Schwartz, *supra* note 14.

31. *See* Kenneth Chang & John Schwartz, *Virgin Galactic's SpaceShipTwo Crashes in New Setback for Commercial Spaceflight*, N.Y. TIMES (Oct. 31, 2014), https://www.nytimes.com/2014/11/01/science/virgin-galactics-spaceshiptwo-crashes-during-test-flight.html.

32. *See, e.g.*, *Update From Mojave: VSS Unity Flies With Propulsion Systems Installed And Live*, VIRGIN GALACTIC, https://www.virgingalactic.com/update-from-mojave-vss-unity-flies-with-propulsion-systems-installed-and-live/ (last visited Dec. 1, 2017.)

33. *See* Andy Pasztor, *Saudi Arabia to Inject 1 Billion into Virgin Galactic Space Venture*, WALL ST. J. (Oct. 26, 2017, 7:27 PM), https://www.wsj.com/articles/saudi-arabia-to-inject-1-billion-into-virgin-galactic-space-venture-1509060475.

seriously by these well-funded organizations, one of which already has developed and delivered to market many rockets capable of delivering payloads to orbit.[34]

C. Domestic and International Regulations on Ballistics

Rockets with the ability to reach orbit are generally classified as munitions and are subject to U.S. regulations and international treaties. The three principal applicable regulatory regimes are the International Trafficking in Arms Regulations ("ITAR"), the Missile Technology Control Regime ("MTCR"), and the Hague Code of Conduct against Ballistic Missile Proliferation ("HCOC").

ITAR are regulations originally promulgated by the U.S. Department of State in 1976 under the authority of the newly-passed Arms Export Control Act ("AECA") to "Ensur[e] commercial exports of defense articles and defense services are consistent with U.S. national security and foreign policy objectives."[35] ITAR classifies SLVs as significant military equipment.[36] ITAR further classifies rockets, SLVs and missiles capable of a range of at least 300km as munitions.[37] Under ITAR, the export of significant military equipment, like SLVs, must receive Directorate of Defense Trade Controls[38] approval.[39] The Department of State has continued to make adjustments to the ITAR regulations, particularly concerning satellites, with the most recent revisions entering into effect in 2017.[40]

The MTCR, established in 1987, is an international policy agreement originally formed between the United States, the United Kingdom, West Germany, France, Italy, Canada, and Japan to restrict sensitive transfers of missiles and related

---

34. *See* SPACEX, *supra* note 15.

35. *See* 22 U.S.C § 2278 (2014); *Directorate of Defense Trade Controls Mission*, U.S. DEP'T OF STATE, http://pmddtc.state.gov/ (last visited Jan. 31, 2019).

36. Significant Military Equipment, 22 CFR § 120.7 (1997).

37. The United States Munitions List, 22 CFR § 121.1 (2018) at Category IV (a)(1)–(2).

38. Submission of Registration Statement, 22 C.F.R. § 122.2 (2013).

39. Exemptions of General Applicability, 22 C.F.R. § 123.16 (2017).

40. *See New Rules Refine Satellite Export Controls*, OFFICE OF SPACE COMMERCE (January 10, 2017), http://www.space.commerce.gov/new-rules-refine-satellite-export-controls/.

technology across international lines.[41] The MTCR today covers 35 countries under its umbrella.[42] The MTCR was developed to restrict the proliferation of physical rocket systems and rocket technology, with the goal of depriving other powers of delivery systems for weapons of mass destruction.[43] The MTCR is not a formal treaty, however, and does not impose any formal obligations on member states.[44] Rather, it is an informal agreement that provides a recommended structure for how to model national regulations in a uniform way across member states.[45] Member states are then encouraged to adopt MTCR guidelines unilaterally.[46] While adoption of specific regulatory and statutory schema to enact the policies varies from country to country (often on the basis of how developed a rocketry or space program, if any, the country possesses), by joining the MTCR each member state agrees to an absolute prohibition on the export of production facilities for the most restricted rocketry systems.[47] Like ITAR, the MTCR defines a restricted rocket system as any ballistic missile, SLV, or sounding rocket[48] capable of a range of 300km or more.[49]

---

41. Missile Technology Control Regime, 22 C.F.R. § 120.29 (2013).

42. *See MTCR Partners*, MISSILE TECHNOLOGY CONTROL REGIME, http://mtcr.info/partners/ (last visited Nov. 16, 2018).

43. "The purpose of these Guidelines is to limit the risks of proliferation of weapons of mass destruction (i.e. nuclear, chemical and biological weapons), by controlling transfers that could make a contribution to delivery systems (other than manned aircraft) for such weapons. The Guidelines are also intended to limit the risk of controlled items and their technology falling into the hands of terrorist groups and individuals." *Guidelines for Sensitive Missile-relevant Transfers*, MISSILE TECHNOLOGY CONTROL REGIME, http://mtcr.info/guidelines-for-sensitive-missile-relevant-transfers/ (last visited Nov. 16, 2018).

44. *See Missile Technology Control Regime (MTCR) Frequently Asked Questions*, U.S. DEPARTMENT OF STATE, (Jan. 20, 2017) https://www.state.gov/t/isn/rls/fs/2017/266847.htm.

45. *See id.*

46. *See id.*

47. *See id.*

48. Sounding rockets are suborbital rockets that deliver a scientific payload to the upper atmosphere or outer space to take measurements. The rocket and instruments then typically fall back to Earth. *See What is a Sounding Rocket?* NASA (Apr. 12, 2004), https://www.nasa.gov/missions/research/f_sounding.html.

49. *Equipment, Sofware, and Technology Annex*, MISSILE TECHNOLOGY CONTROL REGIME,19.A.1 (Oct. 19, 2017), http://mtcr.info/wordpress/wp-content/uploads/2017/10/MTCR-TEM-Technical_Annex_2017-10-19-corr.pdf.

The HCoC, formally known as the Hague Code of Conduct against Ballistic Missile Proliferation and originally spearheaded by MTCR partner states, is a voluntary international agreement that seeks to regulate ballistic missiles capable of delivering weapons of mass destruction through multilateral transparency.[50] Subscribers to the HCoC agree to make a public announcement before conducting an SLV or ballistic missile test-flight or launch.[51] While this code is not considered a binding treaty, it is notable for having gained 139 subscriber states, including all of the MTCR states.

From a United States perspective, these three regulatory systems create a tiered schema for international ballistic technology regulation. ITAR operates at the national level, the MTCR functions among close allies,[52] while the HCoC counts 139 countries as subscribers.[53] Notably absent from this framework are the PRC and North Korea.[54]

II. ANALYSIS

Part A of the analysis will consider how the existing regulatory regime surrounding ballistic technology and SLVs provides important controls on technology that would be extremely dangerous in the wrong hands, but also creates undesirable limitations and uncertainty for the rapidly evolving commercial rocket travel industry. How do ITAR, the MTCR and the HCoC ensure national and international security? In what ways do they fall short? How can they be improved? What nonproliferation goals will become impossible to enforce as emerging technologies become widely available? Part A will seek to address these questions.

---

50. *What is HCoC?* THE HAGUE CODE OF CONDUCT, http://www.hcoc.at/ (last visited Nov. 16, 2018).

51. *Id.*

52. MISSILE TECHNOLOGY CONTROL REGIME, *supra* note 43.

53. *List of HCoC Subscribing States*, THE HAGUE CODE OF CONDUCT, http://www.hcoc.at/?tab=subscribing_states&page=subscribing_states (last visited Nov. 16, 2018).

54. *See Hague Code of Conduct Against Ballistic Missile Proliferation (HCoC)*, U.S. DEPARTMENT OF STATE, https://www.state.gov/t/isn/trty/101466.htm (last visited Oct. 5, 2017). Also notably absent from the HCoC is Brazil, although that country did join the MTCR in 1994. *See Frequently Asked Questions (FAQs)*, MISSILE TECHNOLOGY CONTROL REGIME, http://mtcr.info/frequently-asked-questions-faqs/ (last visited Nov. 16, 2018).

Part B will build on the analysis in Part A to provide policy considerations and recommendations for the near-to-medium future. This section will examine how the existing regulatory schema impact private rocketry entities, as well as how they can be improved, overhauled, or supplanted to encourage competition and innovation in the rocketry private sector. Part B will further examine and identify challenges that are likely to arise in any effort to overhaul regulations on an international level.

A. ITAR, THE MTCR, AND THE HCOC

Taken together, the ITAR, the MTCR, and the HCoC form a regulatory and advisory web that will inform the United States' future decision-making on how to best regulate PTP commercial rocket travel. Perhaps unsurprisingly, the effectiveness of these existing regulatory systems has been mixed. The absence from the HCoC of nations that have developed advanced rocketry systems creates a serious regulatory gap.[55] The PRC possesses its own arsenal of ICBMs and SLVs and is aggressively pursuing development of a manned spaceflight program,[56] while North Korea recently tested a ballistic missile capable of reaching the continental United States.[57] The MTCR counts fewer members among its ranks.[58] Its shortcomings are evident whenever significant proliferation events include non-member nations, such as the sale of DF-3 ballistic missiles by the PRC to Saudi Arabia from 1985 to 1988.[59] Furthermore, non-participants in the MTCR often do not have strong analogous regulatory

---

55. *See* HCoC, s*upra* note 54.

56. *See* Koren, *supra* note 11.

57. *See* Mark Lander, Choe Sang-Hun, & Helene Cooper, *North Korea Fires a Ballistic Missile, in a Further Challenge to Trump*, N.Y. TIMES (Nov. 28, 2017), https://www.nytimes.com/2017/11/28/world/asia/north-korea-missile-test.html.

58. Specifically, the MTCR counts 35 countries as members. *See* HCoC, s*upra* note 54.

59. *See* Hua Di, *China's Case: Ballistic Missile Proliferation*, *in* THE INTERNATIONAL MISSILE BAZAAR: THE NEW SUPPLIERS' NETWORK 163, 170 (William C. Potter & Harlan W. Jencks eds., Westview Press, 1994). While the author argues that the ballistic missiles had a short life-span due to technical design limitations, Saudi Arabia nevertheless was provided with complete ballistic missile systems that could be intimately studied by Saudi Arabian scientists and engineers.

mechanisms for punishing violations of domestic non-proliferation laws and regulations.[60]

The transfer of physical SLV or ballistic missile systems is relatively rare between nations that operate SLVs. This is likely in large part a consequence of the development of sophisticated SLV operations by private corporations, which have been increasingly supplanting governments as the primary providers of SLVs.[61] There is little incentive for a nation to develop its own orbital rocketry program when it can spend far less money to send satellites and other payloads into space with one of the existing SLV providers, and rely on the defense capabilities of more powerful allies in the ballistics arena. The greater concern lies with the proliferation of critical scientific knowledge of ballistic rocketry.[62]

In addition to the weaknesses listed above, the MTCR in particular also faces competition in the form of Russia's Global Control System for the Nonproliferation of Missiles and Missile Technologies ("GCS").[63] The GCS offers access by partner countries to space-launch technology, which is a significantly more open system than the strict restrictions on the international transfer of space-launch technology imposed by the MTCR's guidelines.[64] However, the GCS may be born out of necessity for Russia, which must regularly transfer rocket technology across international borders to its primary orbital launch site in Kazakhstan, the Baikonur Cosmodrome.[65]

---

60. *See, e.g.*, Anastasia A. Angelova, *Compelling Compliance with International Regimes: China and the Missile Technology Control Regime*, 38 COLUM J. TRANSNAT'L L. 419, 441 (1999).

61. *See* Bill Canis, CONG. RESEARCH SERV., R44708, COMMERCIAL SPACE INDUSTRY LAUNCHES A NEW PHASE 1 (2016), https://fas.org/sgp/crs/space/R44708.pdf.

62. In the case of North Korea, the ship already may have sailed; the country appears to have successfully tested an ICBM capable of payload delivery to most of the continental United States. Lander, Sang-Hun, & Cooper, *Supra* note 57.

63. *See* Yuri E. Fedorov, *The Global Control System and the International Code of Conduct: Competition or Cooperation?,* 9 NONPROLIFERATION REV. 30, 33 (2002).

64. *Id*.

65. *See* Andrew E. Kramer, *Russian Space Center in Kazakhstan Counts Down Its Days of Glory*, N.Y. TIMES (June 18, 2013), http://www.nytimes.com/2013/06/19/world/asia/kazakh-town-fades-its-days-of-space-glory-numbered.html.

Lastly, the threat of ballistic rocket technology proliferation must be taken into account before any recommendations can be fully considered.[66] For example, despite crushing international sanctions, North Korea continues to develop both advanced ballistic missile and space-launch vehicle technology.[67] For any nation considering future development, modern computers are more capable of simulating complex systems that previously required extensive physical testing and can significantly reduce the amount of physical test flights required to establish a functioning SLV or ballistic missile system.[68] This holds true for many of the critical components and materials science testing required to complete rocket subsystems, which can be thoroughly vetted by sophisticated supercomputer modeling.[69] Consequently, nonproliferation considerations in policy negotiations for international SLV travel must reflect the realities of the current technological hurdles to ballistic technology, rather than the assumed hurdles of the first decades of spaceflight.

B. POLICY CONSIDERATIONS AND RECOMMENDATIONS FOR THE NEAR- TO MEDIUM-FUTURE

Moving forward, countries with sophisticated launch providers should be prepared to engage in substantial dialogue and negotiation of treaties to provide for the transportation of SLVs between sovereign territories. Just as a conventional red-eye flight from Chicago to Hong Kong departs one sovereign airspace and lands in another, so too would a 40-minute SLV flight between the same destinations pass across international borders.

---

66. *See, e.g.*, DOUGLAS E. MCDANIEL, UNITED STATES TECHNOLOGY EXPORT CONTROL : AN ASSESSMENT 109 (Praeger Publishers, 1993).

67. *See* Choe Sang-Hun, *North Korea Hints It Is Developing More Advanced Ballistic Missiles*, N.Y. TIMES (Aug. 23, 2017), https://www.nytimes.com/2017/08/23/world/asia/north-korea-missiles-kim-jong-un.html?_r=0; *see also* David E. Sanger & William J. Broad, *After Rocket Launching, a Call for New Sanctions,* N.Y. TIMES (Dec. 13, 2012), http://www.nytimes.com/2012/12/13/world/asia/north-korea-rocket-launching.html?src=twrhp&_r=0; *supra* note 57.

68. *See generally*, J.M.A. DANBY, COMPUTER MODELING: FROM SPORTS TO SPACEFLIGHT, FROM ORDER TO CHAOS (Willman-Bell 1997).

69. *Id*.

As a preliminary matter, the wholesale export of SLVs is not likely to present an issue in the near future,[70] given the propensity for legitimate commercial interests to contract with an SLV provider instead of developing their own orbital launch solution.[71] However, the arrival of foreign SLVs in either international waters or sovereign territory will require significant regulatory overhaul and international cooperation. Consequently, revisions should focus on establishing noninterference agreements, rather than focusing on immediate concerns regarding the sale of SLV systems to other parties.[72]

PTP rocket service will likely operate in a similar way to how airlines operate internationally today, with increasingly integrated systems to provide uniform information across the air-traffic control regime.[73] The key difference between the existing aviation industry and the prospective PTP service is the classification of SLVs as munitions and the danger of the proliferation of ballistic technology. The United States likely will not want the PRC to exert sovereign control over a SpaceX SLV that lands on a platform off the coast of Shanghai, but within territorial waters; by the same token, the United States would likely be loathe to permit what it considers to be highly sensitive munitions to land in international waters in the South China Sea. Thus, any agreement between the two countries would almost certainly involve strict requirements that an SLV host country not interfere with, seek to control, or otherwise examine

70. Virtually all sophisticated launch providers operate their own SLVs, while customers purchase or lease space on the rocket; in virtually no instances are SLVs sold by the launch provider to a customer to operate themselves. In one of the few technical exceptions, the U.S. provided the U.K. with Trident missiles under the Polaris Sales Agreement. *Recent Actions Regarding Treaties to Which the United States Is a Party*, 22 I.L.M. 214, 216 (1983). However, while the Trident II is manufactured by Orbital ATK, the sale and transfer to the United Kingdom was executed by the U.S. Government. *Trident II*, NORTHROP GRUMMAN, https://www.orbitalatk.com/flight-systems/propulsion-systems/tridentII/ (last visited Nov. 19, 2018).

71. As will be discussed *infra*, there is a likelihood that portions of some SLV systems will likely be exported as a prerequisite for operation.

72. This does not preclude the possibility of private SLV developers selling SLV systems further down the line, much as airplane manufacturers do today. Given the nascence of the industry, it is left to future scholarship to address the issue of the prospective international trade in SLV systems.

73. U.S. DEP'T OF TRANSP., POINT-TO-POINT COMMERCIAL SPACE TRANSPORTATION IN NATIONAL AVIATION SYSTEM, (Mar. 10, 2010), https://www.faa.gov/about/office_org/headquarters_offices/ast/media/point_to_point.pdf.

or confiscate any SLV or associated equipment while within the host state or international territory.

There is another wrinkle that must be considered, however. In a two-stage PTP service like the one proposed by SpaceX, a first-stage booster rocket must be present at both the launch *and* landing site, lest the second stage landing vehicle be stranded or otherwise require shipment back to the original launch site. In this configuration, the first-stage booster would serve as a local resource, propelling second stages toward their destination before returning to the originating launchpad for reuse. Under this configuration, SpaceX would need to somehow transport a first-stage booster to the destination launchpad *before* international flights begin, ironically triggering the ostensibly less-relevant restrictions on the physical transfer of rockets between sovereign entities.[74]

None of this is to say that the venture is necessarily doomed by the need for complicated and nuanced international diplomacy in the ballistic technology arena; instead, this lucrative new mode of transportation should be seen as an incentive for nations to engage in the difficult work of establishing a new international regulatory regime. Such a formulation is not unprecedented. The Chicago Convention, originally signed on December 7, 1944, established the International Civil Aviation Organization ("ICAO") and officially normalized international air travel on a diplomatic level.[75] This normalization helped usher in the era of mass air transit, with over 42,000 flights per day managed by the Federal Aviation Administration alone.[76] This convention could serve as a model for a future agreement on international commercial rocket travel and will be discussed further in Subsection 2.

Modifications to the existing regulatory environment are necessary to permit countries and private industry to proactively anticipate PTP rocket travel technology and guide the focus of the technological development in this burgeoning industry. As discussed below, this Note recommends that at least the

74. *Supra* Section II, Part A.

75. International Civil Aviation Organization (ICAO), Convention on International Civil Aviation - Doc 7300, 2006, https://www.icao.int/publications/pages/doc7300.aspx (last visited Oct. 11, 2018).

76. *Air Traffic by the Numbers*, FED. AVIATION ADMIN., https://www.faa.gov/air_traffic/by_the_numbers/ (last visited Mar. 8, 2018).

following xx proposals be considered as a starting point: (1) amend the MTCR to grant member states to operate SLVs in other member states; (2) expand the HCoC to provide norms for international commercial rocket travel; and (3) create a new international compact – either independently or as part of the HCoC – to develop normative standards for international suborbital commercial rocket travel.

The existing regulatory regime has largely had to adopt to new innovations in a reactionary fashion after they have already been invented. By providing SLV operators with an understanding of what will ultimately be required of them in an international commercial rocket travel regulatory regime, governments can ensure that they are prepared to benefit from this prospective new industry.[77] SLV operators can also benefit from regulatory clarity, and likely would work to develop PTP rocket technology that conforms with relevant international standards.

1. Operational Status of SLV Operators inside Host Nations and International Waters[78]

a. The MTCR

As a practical first step, a license to operate SLVs in partner states should be incorporated into the MTCR. Partner states will

---

77. As an additional consideration, PTP rocket travel will not be possible without significant integration of rocket flights into the existing international air-traffic control regime. Fortunately, significant upgrades to the National Airspace System have resulted in a more streamlined and integrated data sharing system for managing the United States' airspace. FED. AVIATION ADMIN., NEXTGEN PRIORITIES JOINT IMPLEMENTATION PLAN 2017-2019 EXECUTIVE REPORT 3 (2016), https://www.faa.gov/nextgen/media/NG_Priorities_Joint_Implementation_Plan.pdf (last visited Jan. 22, 2017). The increased need for air-traffic control regulation arising out of the proliferation of commercial rocket travel is not directly addressed by this note.

78. Any regulations or treaties to address this subject will also need to address the operational status of such operators in space, as the current international agreements regarding the status of space are relatively outdated and do little to anticipate the potential for growth. *See, e.g.*, Kirsten Johanson, *Asteroid Mining – Not as Crazy as It Sounds*, MINN. J. of L., SCI., and TECH.: LAWSCI FORUM (Dec. 8, 2014), http://editions.lib.umn.edu/mjlst/asteroid-mining-not-as-crazy-as-it-sounds/. However, this issue falls outside the scope of this note, as straightforward PTP rocket flights will be necessarily suborbital, with the amount of time spent in space by any SLV measured in minutes, not hours.

have a strong incentive to sign on to a uniform agreement if and when sub-orbital commercial PTP flights become a reality. The United States will likely be far more comfortable with a SLV operated by an American entity and launched from New York landing near London, as opposed to Shanghai. The United States and the United Kingdom have pooled critical nuclear technology and weapons for the purpose of international nuclear deterrence for the past 59 years;[79] therefore, it is likely that the State Department would be more amicable to the transfer of *less* sensitive ballistics technology across that specific border. Such an arrangement could serve as an international demonstration of the commercial transportation applications of the technology and, if successful, provide a strong impetus for other nations to come to the negotiating table.

b. The HCoC

An important second step in paving the way to widespread international PTP travel is the expansion of the HCoC to establish regulatory norms for member states, which would effectively require HCoC adoption as a precursor to induction into the international rocket travel community. These limits in the HCoC should include requirements that a host state for an SLV not directly interfere with, study, or confiscate any part of an SLV or associated systems. The U.S. State Department would do well to adopt a standard for the transfer of SLVs between HCoC member states under the revised HCoC limits and requirements.

However, while a general prohibition on foreign SLV interference would help to safeguard against the improper conversion of ballistic technology, it would not by itself defend against all inevitabilities. Imagine, for example, that a fire were to erupt on a platform owned and operated by an American SLV operator off the coast of Shanghai. Would the PRC be barred from providing firefighting services? Would the PRC instead be permitted to fight the fire with boats and helicopters, but not to land personnel on the platform? Imagine instead that a SLV were to crash in a rural province in the Chinese interior. Would the PRC be compelled to prioritize noninterference obligations under the treaty over the potential loss of human life, environmental damage, or national security considerations? The

79. US–UK Mutual Defence Agreement, U.S.–U.K., July 3, 1958.

dilemma posed by these competing obligations can be solved in several ways.

First, the HCoC could provide for limited exceptions to a prohibition on interfering with foreign SLVs in emergency situations. These exceptions would need to provide a mechanism for intimate coordination at the earliest possible time between the host and originating nations, and provide that the SLV operator must conduct the vast majority of recovery work once the risk of loss-of-life or injury had been minimized. On a practical level, regimes with mature spaceflight technology[80] will have little incentive to interfere with a foreign SLV operator's equipment for the purpose of discovering the technological secrets of advanced ballistics; those challenges already have been solved by these nations.[81]

Alternatively, the HCoC could instead be expanded to establish an international entity that would be in charge of managing launch and landing sites, as well as accident and malfunction rapid response and recovery. Participating countries could be required to fund the supervisory entity's operations within their borders. However, while this would ostensibly provide an even playing field for any nation looking to open a spaceport, it also would likely face pushback from countries that do not easily cede sovereign authority within their own borders but nevertheless exercise significant economic and political influence. On a theoretical level, treating a spaceport as foreign soil may be as simple as treating the spaceport as a satellite branch of a local embassy or consulate. In this way, the SLV operator's home nation would have the direct authority to conduct recovery operations at the spaceport. However, permitting origin country personnel to direct and perform recovery operations at a crash site elsewhere in the host country could prove to be more than the host country would be willing to bear, and some intermediary solution would need to be bargained for in treaty deliberations.

2. The Chicago Convention II

Adoption of a new convention based on the necessities of PTP travel by member states of the HCoC would be an important step toward normalizing international attitudes toward PTP

80. E.g. The PRC, the EU, Japan.
81. *Id.*

travel and regulations. This agreement could be either formalized as a part of the HCoC framework or independently established as the Chicago Convention was in the 20th century.[82] Ultimately, such a 'second' Chicago Convention ("Chicago II") could implement technology controls through diplomatic exemptions, sovereignty zones, or reciprocity.

Formulating the convention as an extension of the existing HCoC would potentially provide the PRC with significant motivation to adopt the Code. Even if the remainder of the code remains merely advisory, in practice the effect would be similar to a binding agreement: Nations are expected to abide by the ICAO's standards today,[83] and those that fail to do so run the risk of other countries refusing to receive aircraft originating from the noncompliant origin country. As a lucrative business, PTP travel will provide a major incentive for the PRC to finally join the international community in adopting stricter standards for SLVs and ballistic missiles, as other nations would otherwise simply freeze the PRC out of PTP travel. Given the PRC's recent major investments in space exploration,[84] it is hard to imagine a world in which the PRC is not a major player in the international rocket travel industry. The U.S. should consequently be prepared for the PRC to be present at the negotiating table, and to enter the international ballistic regulatory community.[85]

Alternatively, a Chicago II could be adopted independent of any existing agreement, as was the Chicago Convention.[86] This route would likely be more attractive to countries not already subscribed to the HCoC, as it would provide them with more flexibility to negotiate favorable terms. However, it may be more difficult to pull subscriber states of the HCoC, and particularly MTCR subscribers, to the negotiating table with major players like the PRC operating on uneven regulatory ground.[87] Unlike the Chicago Convention, for which the subject of regulation was widely available and well-understood commercial sector

---

82. INTERNATIONAL CIVIL AVIATION ORGANIZATION, s*upra* note 75.
83. *Id*.
84. Koren, s*upra* note 11.
85. Given the PRC's growing geopolitical clout and ambition, the international community should be prepared for significant demands for concessions at the negotiating table. Koren, *supra* note 11.
86. INTERNATIONAL CIVIL AVIATION ORGANIZATION, *supra* note 75.
87. *See generally* Di, *supra* note 59; Angelova, *supra* note 60.

airplane technology,[88] any prospective convention for normalizing PTP travel regulation would have to contend with the reality that the technology at issue is considered a munition by most involved parties. Wariness over the PRC's relatively weak regulations, paired with a lack of assurance that the PRC will join the international community in adopting uniform standards for regulating ballistic technology, could doom the initiative. Consequently, while an independent agreement should remain in the back pocket of diplomats, an international agreement on normalizing PTP travel would be more likely to succeed if packaged into an existing treaty.

Regardless of the theoretical venue for a Chicago II, the agreement would need to provide a mechanism to provide participating countries with solutions to the existing regulatory challenges regarding SLV systems regularly crossing sovereign boundaries. The following three options, while not mutually exclusive, cover some of the most likely diplomatic issues that will need to be addressed for any Chicago II.

a. Exemptions

Parties to a Chicago II could agree to carve out exemptions in domestic statutory and regulatory arenas to facilitate the departure and arrival of foreign SLVs. This deregulatory approach would require tacit admission by signatories that the ship has sailed on ballistic technology, and would in turn permit SLVs to be regulated much as commercial aircraft are regulated today. While this approach would likely provide the least challenging path forward by effectively deregulating the industry, it could also raise grave concerns regarding the proliferation of ballistic technology to those states that may seek it but do not realistically have the means to develop it independently. Whether states ultimately choose to utilize exemptions will depend largely on their internal assessments regarding the state of international proliferation of ballistic technology.

b. Sovereign Territory

As one of the major issues facing international SLV travel is the control of ballistic technology, one solution could be to ensure that the SLV never actually enters another sovereign space. A

88. INTERNATIONAL CIVIL AVIATION ORGANIZATION, *supra* note 75.

SpaceX platform floating off the coast of Shanghai, for example, would under this arrangement be sovereign U.S. territory. These arrangements would provide the strictest guarantee of technology security while still allowing the operation of SLVs in international contexts, establishing landing sites as pseudo-embassies or consulates.

The pitfalls of this approach bear recognition, however. Parties to this agreement would need to decide who is responsible for managing accidents, providing security, and conducting inspections. This approach also would not solve the related issue of who would be responsible for conducting recovery operations in the event an SLV crashed off-site.[89]

c. Reciprocity

States could ultimately decide to permit SLV travel on a system of reciprocity: States would only agree to receive foreign SLVs from countries that accept their own SLVs in return. This arrangement would, on its face, be least likely to result in proliferation of ballistic technology, since it would retain the 'members only' status quo currently more or less enjoyed by the current SLV operators. However, this would perhaps drive the development of ballistics in countries that otherwise would not enter the arena, and consequently would result in many of the same proliferation concerns as the exemptions option.[90]

Ultimately, it will be up to the states to decide which of these approaches strikes the right balance between regulating a new industry and protecting sensitive technology. Navigating these options will require serious consideration of national security imperatives, economic advantages, and international diplomacy in a burgeoning field.

III. CONCLUSION

Commercial rocket travel looks more promising than ever as an emerging industry, with key technological hurdles overcome

---

89. This concern has recent parallels in regard to secret technology. One of the stealth helicopters used by the U.S. Navy Seals in the raid on Osama bin Laden's compound in Pakistan on May 2, 2011 malfunctioned and was destroyed by the Seals prior to departing; the tail section remained largely intact however, and was likely viewed by Chinese scientists. Mark Mazzetti, *U.S. Aides Believe China Examined Stealth Copter*, N.Y. TIMES (Aug. 14, 2011), https://nyti.ms/2GV9cUE.

90. *Supra* Part B, Section 2, Subsection a.

in recent years. Self-landing rockets have become a pedestrian part of SpaceX's operation, and other companies are eyeing their own innovations in the sector with suborbital international SLV travel in mind. Governments worldwide must make real efforts now to adopt a regulatory regime for international rocket travel, or risk being caught by surprise when the technology matures. By getting in front of sub-orbital commercial rocket technology, governments have the opportunity to shape the development of the industry to better fit expected regulatory schema. This in turn will encourage SLV operators to pursue the market, confident in the support of the international community. By tackling this issue head-on, the United States and the international community can help to usher in a new era of travel on their terms, instead of being taken along for the ride.