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THE NEW ORIENT EXPRESS: CURRENT TRENDS AND REGULATIONS IN SPACE TOURISM AND THE NEED FOR COMMERCIAL HYPERSONIC POINT TO POINT TRAVEL

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I. INTRODUCTION

"[W]e are going forward with research on a new Orient Express that could...take off from Dulles Airport, accelerate up to 25 times the speed of sound, attaining low Earth orbit or flying to Tokyo within 2 hours." -Ronald Reagan[1]

In his 1986 State of the Union Address, President Ronald Reagan ("Reagan") shared his dream of a hypersonic space plane which could fundamentally change

[1] Ronald Reagan, *Address Before a Joint Session of Congress on the State of the Union*, THE AMERICAN PRESIDENCY PROJECT (Feb. 4, 1986), http://www.presidency.ucsb.edu/ws/index.php?pid=36646.

travel and make the world a smaller place.[2] Reagan's words and visions were a means to calm a nation still reeling from the *Challenger* space disaster, and to show the United States' resolve in continuing to explore space.[3] For a time following the address, it seemed this dream would become a reality as NASA began developing a national space plane.[4] However, funding quickly dried up and the US Government abandoned the revolutionary project.[5] However, the space plane was not dead for everyone as billionaire Paul Allen and visionary engineer Burt Ruton (collectively referred to through Ruton's aircraft design company, Scaled Composites, LLC, or "Scaled Composites") aimed to pick up where the US government left off.[6]

On June 21, 2004, Scaled Composites' space plane became a reality, and a paradigm shift began as private enterprise sent a man into space.[7] By piloting Scaled Composites' SpaceShipOne, Mike Melvill became the first civilian pilot to successfully navigate a privately constructed craft into space.[8] More specifically, Melvill and Scaled Composites managed to send a privately funded space mission more than sixty-two miles above the earth's surface.[9] There, Melvill propelled not only SpaceShipOne into orbit, but all of mankind into a brave new frontier where commercial enterprise and innovation looks to pick up the proverbial baton from the world's governments and continue exploration of the cosmos.[10]

Melvill, Scaled Composites, and their craft SpaceShipOne have essentially immortalized themselves as the Wright brothers of the 21st Century. Their private venture was the first of its kind and showed others around the world that space flight and innovation is not a realm solely for exploitation by governmental agencies.[11] Following in SpaceShipOne's wake, is an increasing number of visionary innovators who are fitting the bill for tomorrow's space missions.[12]

Much like the brave new world the Wright Flyer ushered in, questions abound as to what exactly a privatized space tourist industry would look like. In 2001, Dennis

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[2] *See generally id*. (describing Reagan's space policy).

[3] *See generally* M. Mitchell Waldrop, *The Challenger Disaster: Assessing the Implications*, 231 SCI. 661 (1986), (showing the *Challenger* disaster).

[4] *See generally U.S. space "Orient Express" plane project nears reality*, JAPAN ECON. NEWSWIRE, Sept. 3, 1987.

[5] *See generally* Rebecca Grant, *Is the Space Plane Dead?*, 84 A.F. MAG. (Nov. 11 2001), *available at* http://www.airforcemag.com/MagazineArchive/Pages/2001/November%202001/1101spaceplane.aspx (showing the demise of the National Space Plane project).

[6] *See* Brad Stone, *Space Travel: Great Space Coaster?*, NEWSWEEK, June 28, 2004.

[7] *Id.*

[8] *See* Chris Taylor & Kristina Dell, *The Sky's the Limit: Ingenious design. Entrepreneurial moxie. A world-changing vision of the future. The amazing SpaceShipOne has it all.*, TIME, Nov. 29, 2004, at 64 (describing Melvill's flight).

[9] Stone, *supra* note 6.

[10] *See* Taylor, *supra* note 8.

[11] *See id*. (showing the unprecedented nature of SpaceShipOne's flight).

[12] *See Private space flight: Cluster Analysis*, THE ECONOMIST., Dec. 21, 2013, at 122 (showing the current state of private space flight as of December 2013).

Tito, an American millionaire, became the first astronaut to venture into space merely as a tourist.[13] Taken in conjunction with the flight of SpaceShipOne three years later and the space tourism industry was born.[14] However, with this new industry the question becomes how it will be regulated. SpaceShipOne's flight also opened the prospects of agencies like the National Aeronautics and Space Administration ("NASA") increasing their reliance on public-private partnerships to aid their increasingly underfunded missions.[15] Finally, private industry entering the space age has once again spurned the once forgotten idea of creating the next generation of commercial travel.[16]

This paper aims to answer the question of what the new privatized space regime will not only look like, but also if and how it will expand. In answering the question an examination of who will most be affected by space tourism and a subsequent space travel industry is required. Additionally, a cursory look at the history of airline regulation both domestically and abroad is needed to understand the future of private space flight. Next, an overview of past and current space and hypersonic technologies is required to attempt any projection of future advances. Finally, this paper sets out to predict the next ten to fifty years of the private space travel, and ultimately show how such a space travel industry should be regulated. It is the goal of the author to not advocate for this burgeoning private industry, but to encourage continued growth for all of mankind.

II. THE TWOFOLD QUESTION OF HOW THE WORLD'S GOVERNMENTS SHOULD HANDLE THE NEW PRIVATE SPACE TOURISM INDUSTRY AND ALSO CULTIVATE THE INDUSTRY IN RETURNING TO COMMERCIAL SUPERSONIC TRAVEL

A. Whether Government should intensify regulations of commercial space tourism or follow the history of air travel as the prevailing regulatory model

1. The problem regulating space tourism and other commercial space ventures in the United States

As Melvill and Scaled Composites broke the gravitational bonds of earth, the United States Congress ("Congress") attempted to answer the question of how to regulate these new space tourists by passing the Commercial Space Launch Amendments Act of 2004.[17] However, inception of legislation like the CSLAA are merely stepping stones in addressing concerns felt by government agencies tasked with oversight of these private enterprises.[18]

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[13] *Profile: Tito the Spaceman*, BRIT. BROAD. CORP. NEWS (Apr. 28, 2001), http://news.bbc.co.uk/2/hi/science/nature/1297924.stm.

[14] *See* Taylor, *supra* note 8.

[15] *See generally Commercial Crew and Cargo Program (C3PO)*, NAT'L AERONAUTICS AND SPACE ADMIN., http://www.nasa.gov/offices/c3po/home/c3po_goal_objectives.html (last visited Apr. 14, 2014) (showing the increasing use of private companies for NASA use).

[16] *See* Catherine E. Parsons, *Space Tourism: Regulating Passage to the Happiest Place Off Earth*, 9 CHAP. L. REV. 493, 494 (2006).

[17] *See Commercialization of Space Commercial Space Launch Amendments Act of 2004*, 17 HARV. J.L. & TECH. 619, 619 (2004).

[18] *See id*; s*ee generally* Parsons, *supra* note 16 at 512 (addressing the concern of Congress over regulating commercial space flight versus private industries goals).

In the United States, the interplay between government regulation and the freedom to conduct business has always been a difficult tango.[19] The quintessential example of this relationship is the advent of commercial airline transportation.[20] In the early days of flight, air travel was seen as more of a daredevil's stunt or something reserved for the wealthy.[21] During the period following World War II, regulation and oversight were relatively high.[22] However by the 1970s, Congress saw a need to democratize air travel access.[23] In so doing, Congress passed legislation paving the way for deregulation of the commercial airline industry.[24] The result of this period not only spurred innovation in air travel, but allowed many more consumers the ability to fly.[25]

Now with the rise of space tourism, Congress is once again presented with the issue of whether to warrant heavy oversight over commercial space ventures, or to allow for an era of deregulation and allow the industry to self-regulate.[26] The latter approach may be best suited to propel the space tourism industry out of its infancy and into a viable form of travel.[27] Thus, the fundamental question posed to the United States in order to make a new sub-orbital form of travel is whether to provide the minimum or the utmost intervention possible.[28]

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[19] *See generally Production and Commerce Among the States: Carter v. Carter Coal Co.*, 50 HARV. L. REV. 307 (1936) (expounding on the idea of congressional oversight and the opinion of deregulation in the 1930s).

[20] *History: A Brief History of the FAA*, FED. AVIATION ADMIN., http://www.faa.gov/about/history/brief_history/ (last updated Feb. 1, 2010) (explaining the origins of the FAA).

[21] *Id*.; *see also* Lucy C.S. Budd, *On being aeromobile: airline passengers and the affective experiences of flight*, 19 J. OF TRANSPORT GEOGRAPHY 1010, 1010 (2011) (describing the experiences of early flight).

[22] *See* FED. AVIATION ADMIN., *supra* note 20.

[23] *See id*.

[24] *Id*.

[25] *Id*.

[26] *See* Patrick Collins, *The Regulatory Reform Agenda for the Era of Passenger Space Transportation*, PROC. OF 20TH ISTS, Paper No 96-f-13 (1996), *available at* http://www.spacefuture.com/archive/the_regulatory_reform_agenda_for_the_era_of_passenger_space_transportation.shtml (advocating for a similar approach to commercial space travel as that used by the FAA and conventional air travel).

[27] *Id*.

[28] *Id*.; *see also* Spencer H. Bromberg, *Public Space Travel--2005: A Legal Odyssey into the Current Regulatory Environment for United States Space Adventurers Pioneering the Final Frontier*, 70 J. AIR L. & COM. 639, 641 (2005) (emphasizing the importance of deregulation of the fledgling space tourist industry).

2. How will the global community work together in bringing a commercial space plane regime

Any commercial space travel regime will require close cooperation between all the world's governments.[29] The foremost question presented to the international community is how to handle tort liability for private actors holding licenses to operate space vehicles.[30] In a world of privately flown suborbital passenger craft, the potential for disaster can be grave.[31] As such, the world will need to revisit old Cold War era space treaties in an effort to bring more uniformity to commercial spaceflight; the likes of which resemble current commercial aviation.[32]

B. Whether a suborbital space plane regime would alleviate societal in-access to affordable air travel and make air travel more convenient

Though increasing discomfort on commercial air flights has drawn the ire of travelers, an even more disturbing trend is the continuing rise of airfares.[33] As a result, it may fairly be stated that any progress made during the golden age of airline deregulation is being reversed, and air travel is once again only for the privileged.[34]

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[29] *See* Olivia Solon, *Richard Branson: the US has the Best Regulatory Landscape for Private Space Travel*, WIRED (Dec. 3, 2012), http://www.wired.co.uk/news/archive/2012-12/03/virgin-galactic-us-vs-uk (advocating that the United States is best suited to spur innovation for space tourism and beyond). *See also* Michael J. Listner, *International Space Law and Commercial Space Activities: the Rules Do Apply*, THE SPACE REV. (June 3, 2013), http://www.thespacereview.com/article/2305/1 (explaining how the international community will be affected by commercial space travel).

[30] *See generally* Rebecca Davis Reed, *Ad Astra Per Aspera: Shaping a Liability Regime for the Future of Space Tourism*, 46 HOUS. L. REV. 585 (2009) (attempting to answer the question of how to approach liability for space tourism); Mark Flores, *Blast Off?--Strict Liability's Potential Role in the Development of the Commercial Space Market*, 17 RICH. J.L. & TECH. 2 (2006) (advocating for a strict liability regime similar to that of theme parks for commercial space operators).

[31] *See* 1 COLUMBIA ACCIDENT INVESTIGATION BOARD 75, NAT'L AERONAUTICS & SPACE ADMIN. (July 8, 2003), *available at* http://s3.amazonaws.com/akamai.netstorage/anon.nasa-global/CAIB/CAIB_lowres_full.pdf (explaining how the debris field from the Columbia Space Shuttle disaster was so large).

[32] *See generally* Collins, *supra* note 26 (showing how the international community should look at its past before regulating the future of commercial space flight).

[33] *See generally* Rob Lovitt, *Cramped or Comfortable, New Airline Seats Still Put the Squeeze on Fliers*, N.B.C. NEWS (Nov. 4, 2013), http://www.nbcnews.com/travel/cramped-or-comfortable-new-airline-seats-still-put-squeeze-fliers-8C11498663 (showing discomfort of air travel); Scott Mayerowitz, *Cost of Flying Keeps Climbing: Airfares Rise 12 Percent in 5 Years, Not Counting Extra Fees*, ASSOCIATED PRESS (Jan. 16, 2014), http://www.foxnews.com/travel/2014/01/16/cost-flying-keeps-climbing-airfares-rise-12-percent-in-5-years-not-counting/ (showing the rising cost of air travel).

[34] *See generally* Sophia Lee & Kristy Pyke, *Rising Airfare Costs, Added Fees Affect Travel Plans*, DAILY TROJAN (Oct. 10, 2011), http://dailytrojan.com/2011/10/09/rising-airfare-costs-added-fees-affect-travel-plans/ (showing how rising airfare is altering travel plans of college students); *See* Fred L. Smith Jr. & Braden Cox, *Airline Deregulation*, CONCISE ENCYCLOPEDIA OF ECON. (2d ed. 2008), *available at* http://www.econlib.org/library/Enc/AirlineDeregulation.html (showing how deregulation of the airline industry helped open up the airways to a larger consumer market).

The reversal of a democratized air transit system is also effectively shrinking the world, and the problem has no end in sight.[35]

However, all is not lost, and innovators such as European Aeronautic Defence and Space Company ("EADS") are working on projects to revolutionize commercial air travel.[36] A return to commercial faster-than-sound travel will help drive the consumer travel industry into the 21st century.[37] The result will be an increasingly affordable method of space age travel as private companies spur on innovation to compete against one another.[38] Additionally, any new space plane regime would free up conventional air travel to the average consumer, which would also drive the cost of airfare down.[39]

A transition from the novelty of space tourism into a fully operational passenger space plane regime is not a simple task.[40] Many barriers inhibit such a project, least of which include: the cost of research and development; the ability to find a sustainable fuel source; the ability to reduce noise pollution; and any environmental effects of space plane operation.[41] Thus, in order to fully answer the question of how to bring about a space plane regime, the current factors preventing this need to be explored.

III. IMPLICATIONS OF SPACE TOURISM AND A FUTURE PASSENGER SPACE PLANE INDUSTRY

"For once you have tasted flight you will walk the earth with your eyes turned skywards, for there you have been and there you will long to return."
- Leonardo Da Vinci[42]

A. Private companies working to develop space tourism and hypersonic travel technologies

Currently, there are two main types of commercial launch systems in development which are applicable to the space tourism industry: orbital and

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[35] *See generally* Marilyn Adams & Dan Reed, *Rising Costs Reshaping Air Travel Across the USA*, U.S.A. TODAY (May 8, 2008), http://abcnews.go.com/Travel/story?id=4761679 (showing the scarcity of fossil fuels is increasing the cost of travel).

[36] *See* Alex Davies, *The Return of Supersonic Will Revolutionize Travel*, BUS. INSIDER (Sept. 27, 2012), http://www.businessinsider.com/the-return-of-supersonic-flight-will-revolutionize-travel-2012-8 (explaining EADS new Zero Emission Hypersonic Transport).

[37] *Id*.

[38] *Id*.

[39] *See generally* Dr. John Bowen & Dr. Jean-Paul Rodrigue, *The Geography of Transport Systems*, (3d ed. 2013), *available at* http://people.hofstra.edu/geotrans/eng/ch3en/conc3en/ch3c5en.html (indicating the future technology of flight will continue to decrease the cost of travel altogether).

[40] *See generally* Collins, *supra* note 26 (explaining the various factors which need to be explored before a space plane would be feasible).

[41] *Id*.

[42] *See generally Leonardo Da Vinci Quotes*, BRAINYQUOTE, http://www.brainyquote.com/quotes/authors/l/leonardo_da_vinci.html (last visited Apr. 7, 2014) (using Leonardo Da Vinci's quote).

suborbital.[43] Both systems offer potential for growth and innovation, but only the suborbital system appears to be suited for expansion into a viable point-to-point ("P2P") travel model.[44] Thus, it is these suborbital systems and their developers which offer the best chance for the space tourism industry to evolve into a commercial space flight travel industry.[45]

SpaceShipOne's evolution is almost ready for operation in the form of SpaceShipTwo ("SS2").[46] SS2's developer, The Spaceship Company, is a wholly owned subsidiary of billionaire Sir Richard Branson's Virgin Galactic.[47] SS2 promises the ability to take up to six astrotourists on a brief suborbital journey.[48] Conceptually, SS2 is not all too different than the first faster-than-sound aircraft.[49] However, the main difference between Chuck Yeager's historic supersonic flight of 1947 and SS2 is that SS2 propels travelers into actual space.[50] Though SS2 looks to be the most promising application of suborbital space technology, Virgin Galactic is not the only innovator in the suborbital space tourist industry.[51]

Companies like XCOR Aerospace and Blue Origin are also attempting to develop their own suborbital launching craft designed to capitalize on the fledgling space tourism industry.[52] Outside of suborbital crafts like SS2, perhaps the most

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[43] *See* S. Suzette Beard & Janice Starzyk, *Space Tourism Market Study: Suborbital Space Travel*, FUTRON CORP. 4-5 (Oct. 2002), *available at* http://orbitalcommerceproject.com/refdocs/STMS_Suborbital.pdf (showing the two types of space tourist systems: orbital and suborbital).

[44] *Id*. at 37 (explaining how suborbital space tourism my open the market for P2P travel).

[45] *Id.*

[46] *See generally Who We Are*, THE SPACESHIP CO., http://www.thespaceshipcompany.com/about/who_we_are (last visited Jan. 21, 2014) (explaining the origins of SS2).

[47] *Id.*

[48] *See Virgin Galactic Brochure*, VIRGIN GALACTIC http://www.virgingalactic.com/assets/downloads/Virgin_Galactic_Brochure.pdf. (last visited Jan. 21, 2014)

[49] *See id*. (showing how SS2 is towed into the air, released, and then propelled faster-than-sound by a rocket engine); RICHARD P. HALLION, NASA'S FIRST 50 YEARS: HISTORICAL PERSPECTIVES 241 (Steven J. Dick ed., 2009), *available at* https://www.yumpu.com/en/document/view/7095890/the-naca-nasa-and-the-supersonic-hypersonic-frontier (explaining how "Chuck" Yeager's flight system worked).

[50] *See generally* VIRGIN GALACTIC, *supra* note 48 (explaining how SS2 will travel into low-earth orbit at speeds of nearly 3000 miles per hour).

[51] *See generally* FED. AVIATION ADMIN., THE US COMMERCIAL SUBORBITAL INDUSTRY: A SPACE RENAISSANCE IN THE MAKING 5, *available at* http://www.faa.gov/about/office_org/headquarters_offices/ast/media/111460.pdf (detailing current suborbital commercial launch licensees).

[52] *See generally Company Overview*, XCOR AEROSPACE, http://www.xcor.com/overview/ (last visited Jan. 21, 2014) (providing an overview of XCOR's company and their current space craft in development, the Lynx); *About Blue Origin*, BLUE ORIGIN, http://www.blueorigin.com/about/ (last visited Jan. 21, 2014) (providing a brief synopsis of Blue Origin and their suborbital craft, the New Shepard).

intriguing project under development is the EADS's Zero Emission Hypersonic Transport ("ZEHST").[53] Although not a true space plane, ZEHST promises to send passengers from Paris to Tokyo in two and one half hours at an altitude of thirty-two kilometers.[54] In addition to speed and capacity, ZEHST proposes to run on a replenishing fuel source which provides zero carbon emissions.[55] However promising the ZEHST technology is, the project is not supposed to be ready until 2050.[56] Additionally at the 2011 Paris Air Show, both Boeing and Hypermach announced similar developmental hypersonic plane concepts.[57] These are the private players driving the innovation of tomorrow's travel systems.

B. Consumers of Space tourism and the current airline industry

1. Lifestyles of the rich and famous

Twenty million dollars and eight days later, Dennis Tito returned safely to earth and became the first in an ever increasing line of space tourists.[58] Tito, and the affluent citizen pioneers that followed him, blazoned the path to a new tourist marketplace, and helped spur private companies to develop technologies to meet that consumer base's needs.[59] Now, participants in the next wave of space tourism are signing up, and the journey is a fraction of the price Tito paid.[60] Also, the cost of

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[53] *See generally* Bryony Jones, *Race to be the First With 'Son of Supersonic'*, CABLE NEWS NETWORK (June 21, 2011), http://edition.cnn.com/2011/TECH/innovation/06/21/concorde.hyper.sonic/ (announcing the unveiling of ZEHST at the Paris Air Show of 2011).

[54] The boundary of space is generally accepted to be the Karman Line, or 100 km above the earth. *See* S. Sanz Fernández de Córdoba, *100km Altitude Boundary for Astronautics*, *FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE* (May 25, 2014), http://www.fai.org/icare-records/100km-altitude-boundary-for-astronautics; *see also Concorde's Successor Revealed at Paris Air Show*, THE INDEP., June 20, 2011 http://www.independent.co.uk/travel/news-and-advice/concordes-successor-revealed-at-paris-air-show-2300191.html (explaining the proposed cruising altitude of ZEHST which is still almost three times as high as current commercial jetliners).

[55] *See* THE INDEP., *supra* note 54 (explaining how the proposed ZEHST system will work).

[56] *Id*.

[57] *See generally* Jones, *supra* note 53 (explaining the Hypermach SonicStar concept); THE INDEP, *supra* note 54 (explaining how Boeing has announced a hypersonic plane concept to compete with EADS and EADS's parent AirBus Group).

[58] *See generally* Patrick E. Taylor, *Space Tourist, Back from 'Paradise,' Lands on Steppes*, N.Y. TIMES (May 1, 2001), http://www.nytimes.com/2001/05/07/world/space-tourist-back-from-paradise-lands-on-steppes.html?pagewanted=2 (explaining Dennis Tito's journey to the International Space Station as a guest of the Russians).

[59] *See generally* John Schwartz, *Space Tourists: A New Niche?*, N.Y. TIMES (Oct. 24, 2004), http://query.nytimes.com/gst/fullpage.html?res=9C03E6D9123AF937A15753C1A9629C8B63 (explaining the trend towards private space flight).

[60] *See* Maharaj Vijay Reddy et al., *Space Tourism: Research Recommendations for the Future of the Industry and Perspectives of Potential Participants*, 33 TOURISM MGMT. 1093, 1094 (2012) (showing the cost of Virgin Galactic's SS2 for the consumer at $200,000 per

space tourism can be expected to decrease as the industry expands.[61] As such, the space tourism industry will be available to a much larger consumer market in the future.[62] Further, as sub-orbital spaceflight evolves into a P2P travel industry, the cost of space travel will decrease even more.[63] However, P2P space travel will still be an expensive venture, and available to those wealthy individuals who greatly value their time and comfort over what they spend on travel.[64]

2. Average world citizen and their ability to access the current airline industry

Though a viable P2P space travel industry may seem exclusive, at least at first, the impact of such technology on consumers of more conventional air travel will likely be positive.[65] To track one regime change to another, the cost of rail travel was considerably reduced as air travel became prevalent during the twentieth century.[66] Similar to the way rail travel made localized communities closer, air travel has successfully made the world a more global society.[67]

However beneficial air travel has proved in connecting people of the world, there is a growing trend of ever increasing airfare.[68] To stem the tide of rising cost,

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flight); *see* also FED. AVIATION ADMIN., *supra* note 51 (showing SS2 has over 440 customers signed up).

[61] *See* Walter Peeters, *From Suborbital Space Tourism to Commercial Personal Spaceflight*, 66 ACTA ASTRONAUTICA 1625, 1628 (2010) (explaining the product life cycle market theory as it applies to the space tourism industry, and how space tourism will unavoidably enter a maturity phase in which price will continually be reduced).

[62] *See generally* Beard & Starzyk, *supra* note 43 (forecasting the future growth of space tourism as cost falls in the 21st century).

[63] *See* Peeters, *supra* note 61 at 1630 (explaining how cost will continue to decrease in a viable P2P space travel regime beginning with at least fifty daily travelers).

[64] *Id.* at 1631 (estimating an initial ticket offering for a trip from New York to Tokyo at $61,300, or the traditional first class ticket for the same flight with an added $4,500/hour for each hour saved in time).

[65] *See generally* Smith Jr. & Cox, *supra* note 34 (explaining how deregulation of the airline industry in the 1970s opened the door to new technology and consumer friendly pricing models); *see also* Louise Southerden, *Planes v fast trains: 'tortoise' and the air*, THE SYDNEY MORNING HERALD (Mar. 25, 2011, 5.00 PM), http://www.smh.com.au/travel/planes-v-fast-trains-tortoise-and-the-air-20110323-1c6hh.html (showing the difference in cost and convenience of an older technology, rail travel, and a current technology, plane travel).

[66] *See generally* Sarah Metzker Erdemir, *Why Travel by Train?*, U.S.A. TODAY, http://traveltips.usatoday.com/travel-train-9946.html (last visited Jan. 24, 2014) (showing the reduced cost of rail travel during the deregulatory period of passenger air travel).

[67] *See generally* Budd, *supra* note 21 (explaining how air travel has connected the world socially).

[68] See generally Suzie Amer, *Second city blues: the rising cost of airfare means that many smaller cities aren't the bargain they used to be*, SUCCESSFUL MEETINGS (July 1, 2006), available at http://www.successfulmeetings.com/Strategy/Meeting-Strategies/Second-City-Blues/ (showing how rising airfare is preventing travelers from venturing to airports in smaller cities, and in the process, regress the notion of a global society); *Rising Cost of Air Travel*, CARLSON WAGONLIT TRAVEL, http://archive-ie.com/page/135676/2012-07-16/http://www.carlsonwagonlit.ie/en/countries/ie/business-travel-insight/case-studies/rising-

private airline carriers must not only restructure their own businesses, but also invest in the transportation methods of tomorrow.[69] As such, consumers of conventional air travel have just as much to gain as their affluent counterparts in a P2P space plane regime.[70]

C. Potential Tort Feasors

The Space Shuttle Columbia ("Columbia") disaster in 2003 showed the potential havoc a high altitude accident could cause.[71] As Columbia attempted reentry into the earth's atmosphere, it disintegrated raining debris over a large section of the east Texas badlands.[72] Using Columbia as a baseline gauge of what to expect from a potential space tourism/plane disaster, a private operator of a licensed spacecraft would expect to owe a duty of care to all those who live beneath such an operation.[73] Additionally, debris as small as three hundred grams traveling at any speed is thought to be enough to destroy a commercial jet plane, and debris smaller than three hundred grams could still cause massive destruction.[74] If taken to the next logical step, the possibility of a chain reaction from a spacecraft-to-jetcraft-to-ground incident is concerning.[75] Therefore, it is foreseeable the potential amount of tort feasors for a commercial space disaster could be anyone within a large radius in the spacecraft's trajectory.[76]

D. Industry Workers

Aside from the aforementioned private companies developing the current and next generation of space tourism craft, there is also a kindling infrastructure of

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cost-of-air-travel.html (last visited Jan. 24, 2014) (showing rise in airfare in the United Kingdom).

[69] *See generally* Smith Jr. & Cox, *supra* note 34 (explaining how flaws in the current industry structure are negatively affecting airline profit margins and access to the consumer).

[70] *See generally* Chris Nickson, *Advances in Mobile Phones*, A TECH. SOC'Y, http://www.atechnologysociety.co.uk/advances-mobile-phones.html (last updated Aug. 12, 2014) (showing how advances in cell phone technology have made access to older versions of such technology more widespread, and similar advances may be had in the cultivation of the space tourism industry).

[71] *See generally* NAT'L AERONAUTICS AND SPACE ADMIN., *supra* note 31 (talking about the Columbia crash).

[72] *Id*. at 44; *see also* Chris W. Johnson & Marco Sarconi, *Simulating the Risks of Suborbital Space Flight for Air Traffic Management*, SCH. OF COMPUTING SCI., UNIV. OF GLASGOW, *available at* http://www.dcs.gla.ac.uk/~johnson/papers/ISSC2013/Suborbital_formatted.pdf (explaining the debris field for Columbia was over a 2000 square mile area).

[73] *See* Johnson & Sarconi, *supra* note 72 (calculating the probability of debris from Columbia causing ground casualties between .05 and .5).

[74] *Id*.

[75] *Id*. (calculating the probability of Columbia debris striking a commercial jet over rural east Texas at .08).

[76] More specifically, a three hundred fifty mile tract in the path of the craft. *Id*.

operational support forming to service the same.[77] Deep in the deserts of New Mexico, Spaceport America has become the flagship facility for a growing number of public/private endeavors designed to house and operate the space tourism industry's tenants.[78] Spaceport America promises to offer the essential services provided by a conventional airport including: operational support, IT support, hangar space, onsite emergency service, and security.[79] Additionally, Spaceport America plans to offer amenities for guests and customers similar to any major airport.[80] Finally, Spaceport America is just one of a growing number of space facilities dedicated to commercial use, and with each new facility the infrastructure for tomorrow's transportation network grows.[81]

IV. HISTORIES OF AVIATION REGULATION, SUPERSONIC TRAVEL, AND ACCESS TO THE WORLD CONSUMER

"Oh! I have slipped the surly bonds of Earth - Put out my hand and touched the Face of God."

- John Gillespie Magee, Junior[82]

A. Historical review of regulating the airline industry

1. Regulation of air travel in the United States and a brief history of the FAA

Although the Wright brother's initial flight occurred in 1903, it took Congress until 1925 to pass the first meaningful piece of legislation regulating air travel in the United States.[83] Although the Air Mail Act of 1925 facilitated more commercial applications of flight, the Air Commerce Act of 1926 truly allowed for the creation

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[77] *See generally* N.M. SPACEPORT AUTH., STRATEGIC BUSINESS PLAN 2013-2018 (Jan. 2013), *available at* http://spaceportamerica.com/wp-content/uploads/2012/05/NMSA-Business-Plan1.pdf (explaining the current support plan in place for operation of SS2 at Spaceport America in New Mexico).

[78] *Id.; see generally* FED. AVIATION ADMIN., *supra* note 51 (showing the growing number of launch sites in the United States for commercial space tourism); Ian Burrell, *Spaceport Sweden: Lapland Centre to Rival Virgin Galactic's Commercial Space Programme*, THE INDEP. (July 27, 2013), http://www.independent.co.uk/news/science/spaceport-sweden-lapland-centre-to-rival-virgin-galactics-commercial-space-programme-8730957.html (outlining the plan for Spaceport Sweden); *Ready for Takeoff?*, SPACE EXPEDITION CORP. (Apr. 7, 2014), http://www.spacexc.com/en/space-program/spaceports/ (outlining XCOR's Lynx use of Spaceport Curacao).

[79] *See* N.M. SPACEPORT AUTH., *supra* note 77.

[80] *Id*.

[81] See Burrell, *supra* note 78; SPACE EXPEDITION CORP., *supra* note 78.

[82] Peter Armenti, *John Gillespie Magee's "High Flight",* LIBR. OF CONGRESS (Sept. 3, 2013), http://blogs.loc.gov/catbird/2013/09/john-gillespie-magees-high-flight/.

[83] *See Inventing a Flying Machine*, SMITHSONIAN NAT'L AIR & SPACE MUSEUM, http://airandspace.si.edu/exhibitions/wright-brothers/online/fly/1903/index.cfm (last visited Feb. 1, 2014) (showing the date of the first flight of the Wright Brothers airplane); *see generally* FED. AVIATION ADMIN., *supra* note 20 (showing the history of airline regulation and the FAA).

of the airline industry.[84] The Air Commerce Act of 1926 mandated the Secretary of Commerce to essentially create the commercial air industry by approving aircraft for flight, licensing pilots, establishing airways, and developing air traffic rules.[85] Using the Air Commerce Act of 1926, the Secretary of Commerce created the Aeronautics Branch, and later the Bureau of Air Commerce, as the regulatory arm of the Department of Commerce tasked with this commercial flight oversight.[86]

Following a string of air disasters, Congress passed the Civil Aeronautics Act of 1938.[87] This new legislation created the Civil Aviation Authority ("CAA"), a three member safety board tasked with reviewing air accidents and developing new safety measures.[88] In addition, the CAA was authorized to regulate the airfare market and assign specific air routes to independent carriers.[89] After World War II, the amount of civil air traffic doubled and a new answer was needed to regulate the skies over the United States.[90]

In 1958, Congress passed the Federal Aviation Act which created the Federal Aviation Agency, a wholly independent entity within the United States governmental framework.[91] The new Federal Aviation Agency assumed the role of the CAA.[92] In 1966, the Federal Aviation Agency was reformed into the Federal Aviation Administration ("FAA") and placed under the direction of the newly formed Department of Transportation ("DOT").[93] Throughout this time, competition in the airline industry was limited to already established carriers, and the result was limited access for consumers.[94]

However in 1978, Congress passed the Airline Deregulation Act, which had the practical effect of opening the airline industry to new carriers.[95] Additionally,

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[84] FED. AVIATION ADMIN., *supra* note 20.

[85] *Id*.

[86] *Id*.

[87] *Id*.

[88] *Id*.

[89] *Id*. However, this task was given to a new separate agency, the Civil Aeronautics Board, in 1940.

[90] *Id*.

[91] *Id*.

[92] *Id*.

[93] *Id*.

[94] *See generally* Derek Thompson, *How Airline Ticket Prices Fell 50% in 30 years (and Why Nobody Noticed),* THE ATLANTIC (Feb. 28, 2013), http://www.theatlantic.com/business/archive/2013/02/how-airline-ticket-prices-fell-50-in-30-years-and-why-nobody-noticed/273506/ (showing the atmosphere of commercial flight prior to deregulation in the 1970s).

[95] *See generally* FED. AVIATION ADMIN., *supra* note 20 (explaining the Airline Deregulation Act). The ensuing thirty years opened up the skies for consumers at greatly reduced prices. *See* Thompson, *supra* note 94 (showing the reduction in cost of an airline ticket from New York to Los Angeles in adjusted dollars from 1974 to 2013 was nearly $1,200).

deregulation saw the rise of so called low-cost carriers ("LCCs") who serviced localized areas and cut directly into established carriers' market share.[96] In order to adjust to competing LCCs, legacy airline carriers such as Delta established a new strategy whereby the legacy carrier would send larger planes to a centralized hub and from there smaller planes to smaller airports.[97] The result was an ever increasing amount of air traffic, which poses an even larger burden for the FAA in controlling traffic in the skies above the United States.[98]

2. Regulation of air travel outside of the United States

In 1944, the major Allied powers of World War II convened in Chicago, Illinois to determine the future of global air travel.[99] The Convention on International Civil Aviation's ("Chicago Convention") objective was to foster in an international regime where "civil aviation may be developed in a safe and orderly manner and that international air transport services may be established on the basis of equality of opportunity and operated soundly and economically."[100] The Chicago Convention mandated that all countries who ratified the agreement would allow uninhibited access across contracting countries' airways.[101] As a result of the Chicago Convention, the International Civil Aviation Organization ("ICAO") was formed with two main areas of activity.[102] The first was bringing uniform standards for member nations as far as training, licensing, and air traffic rules.[103] Secondly, the ICAO was concerned with the "application of air navigation services and facilities by States and their coordinated implementation in specific areas where operating conditions and other relevant parameters were comparable."[104] In 1947, the ICAO became an arm of the United Nations under the Economic and Social Council.[105] As part of its framework, the ICAO convenes regularly and adopts new international

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[96] *See generally* Bowen, *supra* note 39 (showing the rise of LCCs and the effect they had on so called legacy carriers).

[97] *See Id*. (describing the hub and spoke strategy of air travel).

[98] *Id.*

[99] *See generally* Convention on International Civil Aviation, Dec. 7, 1944, 15 U.N.T.S. 295 [hereinafter Chicago Convention], http://www.icao.int/publications/Documents/7300_cons.pdf (showing the Convention on International Civil Aviation held in Chicago on December 7, 1944).

[100] *Id.*, at 1.

[101] *Id.*, at 4.

[102] *See Foundation of the International Civil Aviation Organization*, INT'L CIV. AVIATION ORG. http://www.icao.int/about-icao/pages/foundation-of-icao.aspx (last visited Feb. 1, 2014) (showing the establishment of the ICAO).

[103] *Id.*

[104] *Id.*

[105] *See About ICAO*, INT'L CIV. AVIATION ORG. http://www.icao.int/about-icao/Pages/default.aspx (last visited Feb. 1, 2014) (showing the date when the ICAO became an official part of the UN).

standards and practices for air regulation.[106] These standards and practices are then ratified by member nations and left for the individual sovereigns to implement.[107] Regular audits of member states are performed by the ICAO to ensure uniform standards and practices.[108]

Additionally, the European Union has established a regulatory arm called the European Aviation Safety Agency ("EASA").[109] EASA helps implement regulations and provides oversight to member nations.[110] Further, the EASA approves aircraft and components for use.[111] However, unlike their American counterparts, EASA does not have legislation in place which is designed to regulate the burgeoning space tourism industry.[112]

3. International tort liability for air disasters: the Warsaw Convention

Prior to the Chicago Convention, representatives from the international community convened in Warsaw, Poland ("Warsaw Convention").[113] The Warsaw Convention established limitations on tort liability for private air carriers and has been ratified by at least one hundred twenty-seven countries.[114] The Warsaw Convention set 125,000 francs as the maximum liability an independent air carrier can suffer for an accident to one of its passengers.[115] Following the Warsaw Convention, many international initiatives were instituted to modernize the provisions.[116]

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[106] *See Making an ICAO Standard*, INT'L CIV. AVIATION ORG. (Nov. 1, 2011), http://www.icao.int/safety/airnavigation/Pages/standard.aspx (detailing how new practices and standards are proposed, ratified, and implemented with the ICAO).

[107] *Id*.

[108] *Id*.

[109] *See generally What we do*, EUR. AVIATION SAFETY AGENCY http://easa.europa.eu/what-we-do.php (last visited Feb. 1, 2014) (describing the function of the EASA).

[110] *Id.*

[111] *Id.*

[112] *See generally* Tanja Masson-Zwaan, *Regulation of Suborbital Space Tourism in Europe: A Role for EU/EASA?*, 35 AIR AND SPACE L. 263, 271 (2010) (showing the current EASA structure does not include regulation of space tourism).

[113] *See Convention for the Unification of Certain Rules Relating to International Transportation by Air* (Feb. 13 1933, SUPP. 28 AM J. INT'L L 84, 84 1934) (introducing the 1929 Warsaw Convention).

[114] *Id*. at 91; *see* Tory A. Weigand, *The Modernization of the Warsaw Convention and the New Liability Scheme for Claims Arising out of International Flight*, 84 MASS. L. REV. 175, 175 (2000) (showing the number of countries to have ratified the Warsaw Convention).

[115] *Convention for the Unification of Certain Rules Relating to International Transportation by Air*, *supra* note 113; *see* Weigand, *supra* note 114, at 178 (showing the capped amount for the Warsaw Convention at $8,300).

[116] *See* Weigand, *supra* note 114. The Hague Protocol in 1955 doubled the liability cap, although the United States did not participate. *See generally* Rene H. Mankiewicz, *Hague Protocol to Amend the Warsaw Convention*, 5 AM. J. COMP. L. 78 (1956) (describing the Hague Protocol). In 1966, the Montreal Interim Agreement was brokered between air carriers

In 1995, the International Air Transport Association ("IATA") amended the Warsaw Convention with their own initiative.[117] IATA is not a governmental agency, but rather a private association of independent air carriers which comprise nearly 85% of modern air traffic.[118] As of February 2000, the IATA agreement raised the liability limit to 100,000 SDR for some one hundred twenty-two carriers.[119] Further and more importantly, in 1999 the ICAO initiated what became known as the Montreal Convention.[120] The Montreal Convention established a two tier system of liability.[121] The first tier established strict liability of up to 100,000 SDR, and the second tier allowed for increased liability if the airline was at fault.[122]

B. History of space tourism and supersonic travel, and regulating the same

1. Birth of faster than sound

The sound barrier was long thought to be a threshold in which no manmade aircraft could surpass.[123] However, innovations during the Second World War drove engineers and scientists to develop new types of jet aircraft.[124] On October 14, 1947, test pilot Chuck Yeager, in the experimental Bell X-1, became the first man to officially be credited with flying faster than sound.[125] The main problem encountered with this new age of supersonic flight was not increasing speed, but rather, how to mask the effect of the sonic boom which an object encounters when it

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servicing the United States, and raised the cap to $75,000. *See* Weigand, *supra* note 114, at 180. The Montreal Protocols of 1975 set to raise liability to a uniform 100,000 SDR, or special drawing rights. Weigand, *supra* note 114, at 181. Special drawing rights were established by the International Monetary Fund, and are a unit measuring a potential claim against an IMF member country. *See Factsheet--Special Drawing Rights*, INT'L MONETARY FUND, Mar. 25, 2014 https://www.imf.org/external/np/exr/facts/sdr.HTM. The Montreal Protocols of 1975 were never ratified by the United States. *See* Weigand, *supra* note 114, at 182.

[117] *Id*. at 182.

[118] *See generally About Us*, INT'L AIR TRANSPORT ASS'N, http://www.iata.org/about/Pages/index.aspx (last visited Feb.1, 2014) (describing IATA).

[119] *See* Weigand, *supra* note 114 at 184.

[120] *See* Tory A. Weigand, *Recent Developments Under the Montreal Convention*, 77 DEF. COUNS. J. 443, 443 (2010) (describing the Montreal Convention).

[121] *Id*.

[122] *Id*. at 443-444.

[123] *See generally* John D. Anderson, Jr., *Research in Supersonic Flight and the Breaking of the Sound Barrier*, *in* FROM ENGINEERING SCIENCE 59, 59 (Pamela E. Mack ed., 1998), *available at* http://history.nasa.gov/SP-4219/Chapter3.html (showing the prevailing fear that aircraft could not go faster than sound).

[124] *See generally id.* (showing the drive to break the sound barrier in a manned flight following World War Two).

[125] Cathy Booth Thomas, *Flying Faster than Sound*, TIME, Mar. 31, 2003 (showing the story of Chuck Yeager and his flight to pass the sound barrier).

goes faster than sound.[126] However, modernization of flight technology increasingly made it more likely for aircraft to safely traverse the sound barrier.[127] As such, the next logical step for supersonic craft was application to commercial supersonic transports.[128]

2. The Concorde Jet and the abandonment of commercial supersonic travel

In 1956, the Supersonic Transport Aircraft Committee was established in Great Britain with the mission to ascertain the feasibility of a supersonic transport.[129] In 1959, the committee urged the British Government to approach the French about combining resources into a joint national venture.[130] As a result of this unlikely Euro-partnership, the Concorde jet was created.[131] Concorde began operation in 1976, and could ferry up to one hundred passengers on a transatlantic flight, under four hours, and at speeds exceeding Mach 2.[132] However, Concorde presented a sound pollution problem resulting from its sonic boom, which ultimately prevented it from flying supersonic over populated areas.[133] Additionally, the cost of Concorde's development ballooned from a projected £160 million to £1.2 billion,[134] with only a handful of aircraft leased for use to British Airways and Air France.[135]

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[126] *See Sound Barrier*, ENCYCLOPEDIA BRITANNICA, INC. (2012) (explaining the effect of the sonic boom).

[127] *Id*.

[128] *See generally* George W. Hilton, *Federal Participation in the Supersonic Transport Program*, BUS. HORIZONS, June 1, 1967, at 21 (showing President Lyndon Johnson's initiative to provide Federal assistance in a 1960s Boeing SST project).

[129] *See Concorde – the Passenger Plane to European Unification*, BRIT. BROADCAST CORP. NEWS (Jan. 16, 2002), http://news.bbc.co.uk/dna/place-lancashire/plain/A669521.

[130] *See* Richard Seebass, *History and Economics of, and Prospects for, Commercial Supersonic Transport*, RTO-EN-4, PAPER NO. 1, Nov. 1998, *available at* http://ftp.rta.nato.int/public/PubFullText/RTO/EN/RTO-EN-004/$EN-004-01.pdf. The name of the eventual aircraft reflects this agreement, as the French word concorde (and its English equivalent concord) means "harmony." *Concord Definition*, DICTIONARY.COM, http://dictionary.reference.com/browse/concord (last visited Apr. 16, 2014).

[131] Seebass, *supra* note 130.

[132] *See* Peter Gillman, *Supersonic Bust: The Story of Concorde*, THE ATLANTIC MONTHLY, Jan. 1997, at 72, http://www.theatlantic.com/past/docs/issues/77jan/gillman2.htm; *see generally Celebrating Concorde: Frequently Asked Questions*, BRIT. AIRWAYS, http://www.britishairways.com/concorde/faq.html (last visited Apr. 7, 2014) (showing average flight time); *Concorde – the Passenger Plane to European Unification*, *supra* note 129 (describing the specifications of Concorde).

[133] *See* Seebass, *supra* note 130.

[134] This is £11 billion in adjusted cost as of 2003. *See* James Arnold, *Why Economists Won't Fly Concorde*, BRIT. BROADCAST CORP. NEWS, Oct. 10, 2003 http://news.bbc.co.uk/2/hi/business/2935337.stm.

[135] *Id*.; *see generally* Seebass, *supra* note 130 (showing the operation of Concorde).

Concorde typically flew with relatively full flights and at a premium rate to comparable subsonic transportation.[136] Additionally, maintenance costs of Concorde were reportedly seven times higher than subsonic aircraft.[137] As a result, airfares for Concorde continued to rise through the 1990s.[138] However, both British Airways and Air France claimed to make a profit on Concorde's use, at least during some operational years.[139] This may be due to the fact that these companies did not have to purchase Concorde from their respective governments.[140]

Prior to 2000, Concorde had an impeccable operational record.[141] This changed on July 25, 2000 when an Air France Concorde flight crashed immediately following takeoff from Paris, killing all one hundred thirteen aboard.[142] The accident was caused by tire debris disabling one of Concorde's engines.[143] After the accident, consumers did not flock back to use Concorde, and in 2003 both British Airways and Air France announced Concorde's retirement.[144] Subsequently, there is no longer a supersonic travel option for consumers.

3. Space Agencies: a brief history of NASA and ESA

Space tourism and any space transport regime will naturally affect the world's various space agencies.[145] As such, a brief overview of the interrelation between governmental space agencies and their response to commercial spaceflight is warranted.

Responding to the first launch of a satellite into low earth orbit by the Soviet Union, Congress passed the National Aeronautics and Space Act of 1958.[146] This

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[136] *See generally* Seebass, *supra* note 130 (describing the late 1990s market comparable to Concorde flights).

[137] *See id.*

[138] *See generally* Edward Wong, *For Concorde, Economics Trumped Technology*, N.Y. TIMES, Oct. 24, 2003 http://www.nytimes.com/2003/10/24/nyregion/24CND-AIR.html (showing the increased cost of Concorde flights were undesirable during downtrodden economic times where business passengers sought lower fares in travel).

[139] *See id.*

[140] *Id*.

[141] *See generally Concorde: What Went Wrong?*, BRIT. BROADCAST CORP. NEWS, Sept. 5, 2000 http://news.bbc.co.uk/2/hi/europe/851864.stm (describing the Air France Concorde Flight 4590's crash).

[142] *Id*.

[143] *Id*.

[144] *Id*.; *see also* Arnold, *supra* note 134 (showing Concorde's retirement).

[145] *See* Masson-Zwaan, *supra* note 122, at 265 (showing the issue of what area of law should regulate space tourism is rooted in both air and space law).

[146] *See generally* Steve Garber & Roger Launius, *A Brief History of NASA*, NAT'L AERONAUTICS & SPACE ADMIN., http://history.nasa.gov/factsheet.htm (last visited Feb. 1, 2014) (describing the reason for congressional action in the wake of Sputnik I's launch); Space Act, Pub. L. No. 85-568, 72 Stat. 426 (1958) (showing the Space Act). In 2010, Congress re-codified the Space Act at 51 U.S.C. § 20101-20103, 20111-20117, 20131-20147, and 20161-20164.

act created NASA as a part of the executive branch.[147] NASA was tasked with not only implementing national scientific research and space flight endeavors, but also to "seek and encourage, to the maximum extent possible, the fullest commercial use of space."[148]

In furtherance of this mandate, and Prior to 2006, NASA limited itself to the use of commercial launching systems to propel scientific equipment and satellites into orbit.[149] Reusable launch vehicle technology ("RLV") was restricted to governmental projects like the space shuttle, which had minimal private integration.[150] However, this model of research and development for space plane technology was unsustainable and many NASA RLV projects were scrapped for want of funding.[151] Couple the lack of new RLV systems with the termination of the aging space shuttle program and NASA was left without the means to ferry their own personnel and equipment into space.[152] Thus, in 2006, NASA refocused their approach to finding new launch systems.[153] The new approach's administrative arm is called the Commercial Crew and Cargo Program Office ("C3PO").[154]

C3PO oversees two major NASA goals.[155] First, C3PO is investing $800 million into partnership agreements with private companies to develop new launch systems designed to take NASA payloads into orbit.[156] Secondly, C3PO has allotted $50 million towards initiatives to deliver crew and personnel into space.[157] From these efforts, two companies, Space Exploration Technologies and Orbital Sciences Corporation, have funded agreements with NASA to develop launch systems to service the International Space Station.[158]

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[147] 51 U.S.C. § 20111 (2010).

[148] 51 U.S.C. § 20112 (2010).

[149] *See The Space Launch Initiative: Technology to Pioneer the Space Frontier*, NAT'L AERONAUTICS & SPACE ADMIN. (Apr. 2002), http://www.nasa.gov/centers/marshall/news/background/facts/slifactstext02.html.

[150] *See generally id.* (showing RLV system use in the 1990s).

[151] *See generally* Grant, *supra* note 5 (showing the demise of the National Space Plane project).

[152] *See generally* Donna Leinwand Leger, *Atlantis Landing Ends 30 Years of Space Shuttle Flights*, U.S. OF AM. TODAY (July 21, 2011), http://usatoday30.usatoday.com/tech/science/space/2011-07-21-shuttle-atlantis-landing_n.htm (showing the end of the space shuttle program).

[153] *See generally NASA Seeks Proposals for Crew and Cargo Transportation to Orbit*, NAT'L AERONAUTICS & SPACE ADMIN. (Jan. 19, 2006), http://www.nasa.gov/home/hqnews/2006/jan/HQ_06029_Crew_Cargo_RFP.html (showing the announcement for the market driven approach of NASA).

[154] *See* NAT'L AERONAUTICS AND SPACE ADMIN., *supra* note 15.

[155] *Id*.

[156] *Id*.

[157] *Id*.

[158] *See generally Commercial Orbital Transportation Services: Overview*, NAT'L AERONAUTICS AND SPACE ADMIN., http://www.nasa.gov/centers/johnson/pdf/636362main_FS-

Additionally, NASA has formed the Emerging Space Office ("ESO") to aid private space endeavors like SS2.[159] ESO "[s]upports stimulatory partnerships that can encourage early-stage companies and promising entrepreneurs."[160] Further, ESO researches and monitors entrepreneurial trends in order to assess and strategize for the future of the private space industry.[161]

In Europe, the European Space Agency ("ESA") was formed to coordinate the efforts of member nation's space programs in order to ensure peaceful use of space and provide a unifying European identity.[162] Though an agency comprised of many nations, ESA is the functional European equivalent of NASA.[163] As of 2007, the official policy of the ESA made only sparse reference to improving commercial launch activities.[164] Further, ESA approaches private sub-orbital space flight with "cautious interest and informed support."[165] Such an official stance has led some European space entrepreneurs to turn to the friendlier regulatory environment of the United States.[166]

4. Space tourism and current governmental responses to the industry

As Scaled Composites geared up to launch SpaceShipOne, Congress sought to pass new legislation aimed at answering the question of how to provide oversight to

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2012-04-014-JSC%20COTS1-pager.pdf (last visited Apr. 15, 2014) (showing parties with funded agreements with NASA).

[159] *See generally What is Emerging Space?*, NAT'L AERONAUTICS AND SPACE ADMIN. http://www.nasa.gov/offices/oct/emerging_space/index.html#.Uwqt-vldWUU (last visited Apr. 15, 2014) (describing the Emerging Space Office).

[160] *Id*.

[161] *Id*.

[162] *See Welcome to ESA: A European Vision*, EUR. SPACE AGENCY, http://www.esa.int/About_Us/Welcome_to_ESA/A_European_Vision (last updated June 1, 2011); *Welcome to ESA: Space for Europe*, EUR. SPACE AGENCY, http://www.esa.int/About_Us/Welcome_to_ESA/Space_for_Europe (last updated Feb. 12, 2013).

[163] *See generally 1964-2014: fifty years of European cooperation in space*, EUR. SPACE AGENCY, http://www.esa.int/About_Us/Welcome_to_ESA/ESA_history/1964_2014_fifty_years_of_European_cooperation_in_space (last visited Feb. 1, 2014) (showing ESA is an organization devoted to scientific and engineering applications for space).

[164] *See generally 4th Space Council: Resolution on the European Space Policy*, COUNCIL OF THE EUR. UNION, May 22, 2007, *available at* http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/intm/94166.pdf (showing the limited mention of commercial enterprise in ESA policy).

[165] *See Space Hitch-Hiker: Commercial Spacecraft With Room to Carry Experiments Could Give Science a Lift*, 467 NATURE 1006 (2010), http://www.nature.com/nature/journal/v467/n7319/full/4671006a.html.

[166] *See generally* Solon, *supra* note 29 (showing Virgin Galactic's Richard Branson favors the regulatory system of the United States).

the commercial space industry.[167] However, the idea of commercializing space was not new to the United States.[168] One of Congress' first attempts at answering this question came in the Commercial Space Launch Act of 1984.[169] This act established the DOT as the initial regulatory agency charged with issuing private space launch licenses; setting requirements for obtaining such licenses; and the overall regulation of the commercial space launch industry.[170] The DOT used their new regulatory powers to create the Office of Space Transportation ("AST").[171]

Coming off the heels of delivering his powerful 1986 State of the Union Address, Reagan redirected the space policy of the United States.[172] In 1988, Reagan signed a National Directive which attempted to lay a framework for the United States and their space program as the new millennium approached ("1988 Space Policy").[173] One of the 1988 Space Policy's premiere goals was to "...encourage...the commercial use and exploitation of space technologies and systems" and to "...encourage other countries to engage in free and fair trade in commercial space goods and services."[174] The 1988 Space Policy also stated that regulations of the commercial space industry should only be "...to the extent required by law, national security, international obligations, and public safety."[175] To answer Reagan's 1988 Space Policy, Congress explored possible reforms to the 1984 Commercial Space Launch Act.[176] From this, the Commercial Space Launch Amendments Act of 1988 was passed.[177] This new legislation made the commercial space launch industry more appealing to private companies by setting new limits for insurance requirements and potential liability.[178]

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[167] *See generally Commercialization of Space Commercial Space Launch Amendments Act of 2004*, *supra* note 17 (showing Congress's attempt to legislate commercial space in light of SpaceShipOne's flight).

[168] *See* Commercial Space Launch Act, Pub. L. No. 98–575, 98 Stat. 3055 (1984); *see also* Bonnie E. Fought, *Legal Aspects of the Commercialization of Space Transportation Systems*, 3 BERKLEY TECH. L.J. 99, 100 (1988) (describing the early days of commercial space ventures and legislation).

[169] Commercial Space Launch Act, *supra* note 168.

[170] *Id.*

[171] *See About the Office*, FED. AVIATION ADMIN., http://www.faa.gov/about/office_org/headquarters_offices/ast/about/ (last updated Sept. 9, 2014).

[172] *See generally* Fought, *supra* note 168, at 100 (showing Reagan's new space policy).

[173] *"Presidential Directive on National Space Policy," February 11, 1988*, FED'N OF AM. SCIENTISTS, http://www.fas.org/spp/military/docops/national/policy88.htm (last visited Apr. 15, 2014).

[174] *Id*.

[175] *Id*.

[176] *See* Kim G. Yelton, *Evolution, Organization and Implementation of the Commercial Space Launch Act and Amendments of 1988*, 4 J.L. & TECH. 117, 133-134 (1989).

[177] *See* Commercial Space Launch Amendments Act of 1988, Pub. L. No. 100–657, 102 Stat. 3900 (1988).

[178] *Id.*

The commercial space launch industry of the 1980s and 1990s mainly saw private companies launch expendable vehicles into space carrying private or governmental payloads.[179] While an important step in the commercialization of space, this launch industry fell short of Reagan's space policy goals. This soon changed as private innovators, such as those at Scaled Composites, developed a new age of private space activity. In addition to the private aviation innovators, private citizens expressed a desire to enter space for a premium.[180] As a result of these new private sector pioneers, Congress was forced to once again revisit their commercial space legislation.[181]

In 1995, DOT reconfigured AST and firmly placed it under the umbrella of the FAA.[182] The new office's mission was to "encourage, facilitate, and promote commercial space launches and reentries by the private sector."[183] With the newly restructured AST, the FAA began implementing new regulations to track the growing need for oversight of the commercial space industry as it progressed from NASA's charter service to a privatized tourist industry.[184]

Following this, Congress passed the Commercial Space Launch Amendments Act of 2004 ("CSLAA").[185] The act provides a guideline for space regulation across the United States, and requires individual states to make space law consistent with or more stringent than the provisions of the CSLAA.[186] In addition to requiring AST to issue and regulate operating licenses, the CSLAA establishes that operators of commercial launch vehicles need to maintain liability insurance or an ability to pay in an amount determined by the Secretary of Transportation.[187] Further, the operator need not maintain liability insurance for each launch and reentry in amount exceeding $500 million for potential loss to third parties or the maximum reasonable amount on the world market.[188] Additionally, the United States Government will

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[179] *See generally* William G. Schmidt et al., *Aviation and Aerospace Law*, 33 INT'L LAW. 483, 490-491 (1999) (showing developments in commercial space launches through the 1990s, such as, the Launch Services Purchase Act of 1990 and Commercial Space Act of 1998).

[180] *See* Taylor, *supra* note 58.

[181] *Commercialization of Space Commercial Space Launch Amendments Act of 2004*, *supra* note 17.

[182] FED. AVIATION ADMIN., *supra* note 171.

[183] *Id*.

[184] *See generally New Regulations Govern Private Human Space Flight Requirements for Crew and Space Flight Participants*, FED. AVIATION ADMIN., (last updated Feb. 7, 2007), http://www.faa.gov/about/office_org/headquarters_offices/ast/human_space_flight_reqs/ (explaining the new AST regulations in the wake of the Commercial Space Launch Amendments Act of 2004).

[185] *See* Commercial Space Launch Amendments Act of 2004, Pub. L. No. 108–492, 118 Stat. 3974 (2004) (codified at 49 U.S.C. §§ 70101-70121 (2006) and later revised at 51 U.S.C. §§ 50901-50923 (2010)). Further, the FAA promulgated the act in several regulations at 14 CFR Parts 401, 415, 431, 435, 440 and 460.

[186] 51 U.S.C. § 50919(c) (2010).

[187] 51 U.S.C. § 50914(a)(1-2) (2010).

[188] *Id.* § 50914 (a)(3).

provide indemnification for a claim against a licensed operator of up to $1.5 billion above the initial $500 million in liability coverage.[189] In order for a licensed operator to receive payment for indemnification of a third party claim exceeding $500 million the operator must make an application to Congress showing need for coverage under the CSLAA's indemnification provision.[190] This risk-sharing model is believed to be able to spur the commercial spaceflight industry until the insurance market could stabilize and account for the potential catastrophic loss associated with a commercial space vehicle.[191] However, according to the FAA in 2006, the commercial space insurance industry remained "fragile."[192]

According to the CSLAA, licensees of commercial launch vehicles are required to make reciprocal waiver claims with "its contractors, subcontractors, and customers, and contractors and subcontractors of the customers, involved in launch services or reentry services."[193] Each party to the reciprocal waiver "agrees to be responsible for property damage or loss it sustains" as a result of its actions or those of their employees.[194]

Finally, passengers, called "spaceflight participants" under the act, must be made aware of all known dangers of such flight, in writing prior, to initiating any compensated agreement to ride.[195] Further, spaceflight participants are required to provide their informed consent in writing that they have been made aware of the dangers and have satisfied all other provisions under the CSLAA.[196]

5. International Theories of Liability and Regulation of Commercial Space Travel

On the eve of manned spaceflight to the moon, the United Nations crafted a multilateral treaty between spacefaring nations known as the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies ("Outer Space Treaty").[197] However, the Outer Space Treaty was ratified in a time where commercialized use of space was unforeseeable.[198] As a result, it would appear that each country would be

[189] 51 U.S.C. § 50915(a) (2010).

[190] *Id.* § 50915 (b).

[191] *See* Reed, *supra* note 30 at 596-597 (showing the reason for the CSLAA liability scheme).

[192] *See generally id*. at 598 (describing a FAA study of the commercial space insurance industry's viability).

[193] 51 U.S.C. § 50914(b)(1) (2010).

[194] *Id.*

[195] 51 U.S.C. § 50905(b)(5)(A)-(B) (2010).

[196] *Id*. at (b)(5)(C).

[197] *See generally* Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, U.S.-Eng.-Russ., Jan. 27, 1967, 18 U.S.T. 2410 (U.S. Treaty) [hereinafter Outer Space Treaty].

[198] *See Id*. The treaty was drafted in 1967, which was a time when there was no private space activity, and as such, the treaty itself does not mention private actors.

at fault for space catastrophes caused by their own citizens, including private enterprises.[199]

In 1972, the Convention on International Liability for Damage Caused by Space Objects ("Space Liability Treaty") supplanted the Outer Space Treaty.[200] The Space Liability Treaty assigns no limit on liability to states which launch spacecraft.[201] Further, the Space Liability Treaty imparts absolute liability on launching states for damage done to the earth or aircraft.[202] If damage is done to another spacecraft then liability is based on fault.[203] Finally, the Space Liability Treaty is not conducive to private space activity as it only allows claimants to bring their claims against the launching state directly, with no mention of the private actor.[204]

6. Supersonic to hypersonic in the 21st century: the x planes and beyond

Hypersonic speed typically refers to airspeeds of at least five to seven times the speed of sound. Such unstable and high rates of speed have rarely been achieved.[205] However, the development of hypersonic technology was thought crucial to foster in the space plane regime envisioned by Reagan.[206]

The first successful application of hypersonic technology in a manned flight occurred in 1959 with the X-15's first powered flight.[207] Produced as a joint endeavor by NASA and the United States Military, the X-15 achieved speeds six times the speed of sound, and reached altitudes of sixty seven miles.[208] The latter makes the X-15 the first true space plane.[209] However, the X-15 was to be a fast strike military vehicle, and not a practical civilian transport.[210]

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[199] Outer Space Treaty, *supra* note 197, at art. VI. Article VI provides that "[t]he 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."

[200] Convention on International Liability for Damage Caused by Space Objects, U.S.-Eng.-Russ., Mar. 29, 1972, 24 U.S.T. 2389 (U.S. Treaty) [hereinafter Space Liability Treaty].

[201] *See generally id* (showing the lack of liability in the Space Liability Treaty).

[202] Space Liability Treaty, *supra* note 200, at art. II.

[203] Space Liability Treaty, *supra* note 200, at art. III.

[204] Space Liability Treaty, *supra* note 200, at art. VIII.

[205] *See generally Welcome to NASA's Guide to Hypersonics*, NAT'L AERONAUTICS & SPACE ADMIN., http://www.grc.nasa.gov/WWW/BGH/index.html (last visited Apr. 7, 2014) (showing the only piloted hypersonic aircraft have been various space rocket-craft, the X-15, and the space shuttle).

[206] *See generally* Barbara Ruldolph, *Round the World in 120 Minutes: All aboard the Orient Express, but not Until the 21st Century*, TIME, Feb. 17, 1986, at 56 (explaining the need for hypersonic technology).

[207] *See* NASA, *X-15: Hypersonic Research at the Edge of Space*, NAT'L AERONAUTICS & SPACE ADMIN., http://history.nasa.gov/x15/cover.html (last updated Feb. 24, 2000).

[208] *Id*.

[209] *Id*.

[210] *Id*.

Following the 1988 Space Policy's goal of developing a new hypersonic suborbital civilian transport, NASA placed a bid to civil aeronautics contractors to design the same.[211] The result was a public-private enterprise called the National Aero-Space Plane project ("NASP").[212] Though technically still apart of the Department of Defense, NASP's goals were to research the requisite technologies needed to advance hypersonic technologies for future peaceful applications.[213] The first experimental craft from NASP was to be the X-30.[214]

The X-30 was a proposed single-stage launch vehicle which would take off and land like a conventional aircraft.[215] Once off the ground, the X-30 would be able to enter space and orbit Earth.[216] However promising the X-30 project was, it quickly went over budget by five hundred percent, and X-30's initial test flights were periodically postponed.[217] X-30 and NASP's fate was ultimately sealed with the end of the Cold War, and the project was cancelled in 1994.[218]

Utilizing the lessons learned from NASP, NASA went forward with a new hypersonic development program called Hyper-X.[219] This new program's objective set out to construct an air-breathing launch vehicle which could travel at speeds in excess of Mach 10.[220] The banner technology of the Hyper-X program was the use of scramjet engines.[221] Typical rocket engines combine liquid fuel with liquid oxygen stored onboard a vehicle in order to combust and propel the craft.[222] Scramjets remove the need for liquid oxygen, and instead combine oxygen taken

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[211] *See generally* Mary L. Sandy & Maj. Robert Perry, *DOD/NASA Announce National Aero-Space Plane Contractor Team*, NAT'L AERONAUTICS & SPACE ADMIN., (May 24, 1990), http://www.nasa.gov/home/hqnews/1990/90-071.txt (showing the development of the X-30 program).

[212] *Id.*

[213] *Id.*

[214] *Id.*

[215] *See generally* Drucella Anderson & Don Haley, *NASP Propulsion Tests Planned for NASA SR-71*, NAT'L AERONAUTICS & SPACE ADMIN. (Mar. 4, 1992), http://www.nasa.gov/home/hqnews/1992/92-029.txt (explaining the objective of the X-30 craft).

[216] *Id*.

[217] *See generally* Grant, *supra* note 5 (showing the decline of the NASP).

[218] *Id*.

[219] *See generally NASA Dryden Past Projects: X-43A Hypersonic Flight Program*, NAT'L AERONAUTICS & SPACE ADMIN. (Nov. 3, 2009), http://www.nasa.gov/centers/dryden/history/pastprojects/HyperX/#.UyhXmPldWUU (showing the history of Hyper-X).

[220] *Id.*

[221] *Id.*

[222] *See generally What's a Scramjet*, NAT'L AERONAUTICS & SPACE ADMIN. (Jan. 30, 2004), http://www.nasa.gov/missions/research/f_scramjets.html (showing the manner in which scramjets work).

from the air passing through the vehicle.[223] The result is a lighter and much faster vehicle.[224]

The Hyper-X test vehicle, the X-43A, flew three successful missions using the scramjet.[225] The third X-43A flight had the goal of achieving and sustaining Mach 10.[226] On November, 16 2004, at an altitude of around 90,000 feet, the X-43A achieved sustained flight at Mach 9.6 for more than ten seconds.[227] Though, the X-43A was an unmanned aircraft, it was hailed by NASA as providing invaluable flight data for the first serviceable scramjet engines.[228]

As the Hyper-X project drew to a close, NASA's next X vehicle was almost set to launch.[229] The X-37 series of vehicles are unmanned and designed to "evaluate more than forty propulsion, airframe, and operations technologies designed to lower the cost of access to space."[230] Ferried into space by expendable rockets, the X-37B orbits the earth and reenters the atmosphere in the Mach 25 range where it lands like the traditional space shuttle.[231]

Though rising costs and delays have forced the X-37 project outside of the purview of NASA and into oversight by the US Defense Advance Research Projects Agency ("DARPA"), the X-37B has had three successful missions with the second far exceeding its nine month mission parameters.[232] Due to X-37's move to

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[223] *Id.*

[224] *Id.*

[225] *See* NAT'L AERONAUTICS & SPACE ADMIN., *supra* note 219.

[226] *Id.*

[227] *See Id.;* NAT'L AERONAUTICS & SPACE ADMIN., *supra* note 222 (showing the altitude of X-43A).

[228] *See generally NASA Armstrong Fact Sheet: Hyper-X Program*, NAT'L AERONAUTICS & SPACE ADMIN. (Feb. 28, 2014), http://www.nasa.gov/centers/dryden/news/FactSheets/FS-040-DFRC.html (showing the benefits of X-34A).

[229] *See generally* June Malone, *X-37 Demonstrator to Test Future Launch Technologies in Orbit and Reentry Environments*, NAT'L AERONAUTICS & SPACE ADMIN. (Mar. 2003), http://www.nasa.gov/centers/marshall/news/background/facts/x37facts2.html (showing the scheduled test flights of the X-37 Approach and Landing Test Vehicle).

[230] *Id.* (The X-37B is a functioning space plane designed for orbital missions of at least nine months); Dennis R. Jenkins et al., *American X-Vehicles: An Inventory, X-1 to X-50 47*, NAT'L AERONAUTICS & SPACE ADMIN. (June 2003), *available at* http://history.nasa.gov/monograph31.pdf (quoting NASA's synopsis of the X-37 mission). The X-37B is a functioning space plane designed for orbital missions of at least nine months. *Id.*

[231] *See* Guy Norris, *Down and Back*, AVIATION WK. & SPACE TECH., June 25, 2012, at 37.

[232] *See generally Scaled-back X-37 approach and landing vehicle faces drop test*, FLIGHT INT'L, (Apr. 4, 2006), http://www.flightglobal.com/news/articles/scaled-back-x-37-approach-and-landing-vehicle-faces-drop-205787/ (showing the move from NASA to DARPA); Maj. Eric Bader, *Air Force Launches 3rd X-37B Orbital Test*, STATES NEWS SERVICE, (Dec. 11, 2012) (showing X-37B's third mission launch was a success and was the first re-launch of an X-37B test vehicle); Norris, *supra* note 231 (explaining X-37B's second test flight orbited the earth for 469 days).

DARPA, the project has become highly classified.[233] However, technology eventually gleaned from continued success of the X-37 can only assist civilian space faring vehicles.[234]

Private applications of hypersonic technology are developing as well.[235] Hypermach, an international private enterprise, is currently developing a supersonic business jet called the SonicStar.[236] SonicStar promises to use modified hybrid ramjet technology to propel ten to twenty business clients to destinations at Mach 4 and at a cruising altitude of more than 60,000 feet.[237] SonicStar also proposes to reduce traditional jet emissions by one hundred percent and eliminate the detrimental effects of the sonic boom.[238]

In conjunction with SonicStar's announcement, EADS's ZEHST was announced at the 2011 Paris Air Show.[239] ZEHST is a similar clean burning supersonic application to that of SonicStar, with the major difference being ZHEST's promise to carry eighty to one hundred passengers.[240] Additionally, ZEHST will utilize both traditional turbojet engines to propel the craft to just below supersonic levels and rocket boosters to hurl the craft to Mach 4.[241] However, unlike SonicStar, ZEHST is not feasible until at least 2050, but a test demonstrator similar to the X-37 may be available as early as 2020.[242] Finally, vehicles like XCOR's Lynx and Virgin Galactic's SS2 are not quite hypersonic platforms, but their development is paving the way for future faster applications.[243]

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[233] *See* Norris, *supra* note 231.

[234] *See generally* Malone, *supra* note 229 (explaining NASA's original goal of X-37 was to push space-age technology as a whole into the 21st-century).

[235] *See generally The Science*, HYPERMACH AEROSPACE LTD., http://hypermach.com/?page_id=66 (last visited Apr. 7, 2014) (detailing Hypermach's supersonic business jet set to operate in 2021).

[236] *See About Us*, HYPERMACH AEROSPACE LTD., http://hypermach.com/?page_id=18 (last visited Apr. 7, 2014).

[237] *See* HYPERMACH AEROSPACE LTD., *supra* note 235.

[238] *See* HYPERMACH AEROSPACE LTD., *supra* note 236.

[239] *See generally Paris Airshow 21st June 2011*, HYPERMACH AEROSPACE LTD., http://hypermach.com/wp-content/uploads/2012/11/HyperMach-launches-SonicStar.pdf (last visited Apr. 7, 2014) (showing the announcement of SonicStar); James Boxell, *Futuristic Zehst Primed for 2050 Take-Off*, FIN. TIMES, June 20, 2011, at 14, http://www.ft.com/cms/s/0/e67035fc-9a95-11e0-bab2-00144feab49a.html#axzz3FtXpFhx2 (announcing ZEHST at the 2011 Paris Airshow).

[240] *See* Boxell, *supra* note 239.

[241] *Id.*

[242] *Id.*

[243] Both SpaceShipTwo and Lynx do not exceed speeds of Mach 4. *See* VIRGIN GALACTIC, *supra* note 48; XCOR AEROSPACE, *supra* note 52.

C. Affordability of aviation for the consumer

Prior to US airline deregulation in 1978, the Civil Aeronautics Board ("CAB") set prices for US air travel.[244] CAB was an administrative agency tasked with setting US airfares.[245] Under CAB, airfares were determined on a per-mile traveled basis, which in principle ensured equality for all air travel consumers.[246] However, in reality airfares did not take into account the operating costs required to service routes.[247] The result left legacy carriers to compete solely on the quality of their individual airline.[248] Additionally, new carriers could not enter the market and compete with established legacy carriers because routes and pricing were predetermined by CAB.[249]

However, the Airline Deregulation Act of 1978 ushered in the end for CAB, which ultimately ceased operation in 1984.[250] Today, three economic principles help carriers set airfare pricing: cost-based pricing, demand-based pricing and service-based pricing.[251]

Cost-based pricing essentially looks at the marginal cost to the airline per passenger.[252] In other words, what it actually costs the airline to transport one passenger.[253] Thus, cost-based pricing sets a fare at or near the actual cost of transport for the passenger.[254]

Demand-based pricing takes into account the current trends in demand for an airline consumer.[255] When demand is high, so will be the price of a ticket.[256] Finally, service-based pricing accounts for the quality of the flight for the consumer.[257] As such, the lower amount of services provided on a given flight will lead to a lower fare.[258]

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[244] *See* Eran Rubin & Benny Mantin, *Tabulated Decision Aids and Airfare Pricing*, 11 ELECTRONIC COM. & RES. APPLICATIONS 159, 160 (2012).

[245] *See generally* FED. AVIATION ADMIN., *supra* note 20 (explaining the origins of CAB).

[246] *See* Rubin & Mantin, *supra* note 244.

[247] *Id.*

[248] *See* Smith Jr. & Cox, *supra* note 34 (explaining the effect of CAB regulation).

[249] *Id.*

[250] *Id*.; *see also Regulation: A Gala Goodbye to the CAB*, TIME, Oct. 1, 1984, at 69 (showing the end of CAB).

[251] *See* Rubin & Mantin, *supra* note 244.

[252] *Id*.

[253] *Id*.; *see Marginal Cost Pricing*, BRITANNICA CONCISE ENCYCLOPEDIA (2012).

[254] *See* Rubin & Mantin, *supra* note 244.

[255] *Id*.

[256] *Id*.

[257] *Id*.

[258] *Id*.

In the United States, there are two types of carriers, legacy and LCCs.[259] Legacy airline carriers operate from centralized hubs outward.[260] Thus, on a legacy carrier one would expect to leave a local airport, travel to a hub, and then venture to a distant destination.[261] LCCs, however, operate typical P2P routes in a given region.[262] Finally, loyalty programs, such as frequent flyer incentives, encourage consumers to stay loyal to a given carrier by providing discounted fares for recurring customers.[263]

Though deregulation has essentially eliminated federal oversight in setting market rates for airfares, the US Department of Justice still retains jurisdiction to enforce antitrust laws and prohibit proposed carrier mergers.[264] Such action by the Department of Justice, may unnecessarily preserve failing companies and force increased airfares as these companies attempt to stay solvent.[265]

Additional factors such as federal control of air traffic and lack of new air facilities also contribute to increased airfares.[266] Federal law allows airports to only collect "reasonable fees" from carriers for use of facilities.[267] The result prevents existing airports from constructing necessary expansions and upgrades.[268] As such, air traffic continues to increase, and there are no new facilities to service the new growth.[269] Further, as some economists suggest, removing the business-like function of air traffic control from the FAA and privatizing the same may also reduce the cost of travel.[270] Such a move may reduce congestion because it will allow for private innovations in traffic control and eliminate the FAA's antiquated control systems.[271] Currently the FAA allows flights on a first-come first-serve basis, which leads to delays during peak flying hours. Privatization of air traffic control may be difficult and cumbersome in the United States due to the sheer volume of air traffic.

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[259] *Id*.

[260] *Id*.

[261] *Id*.

[262] *Id*., at 161.

[263] *Id*.

[264] *See* Smith Jr. & Cox, *supra* note 34. For example in 2013, the Department of Justice attempted to block a proposed $16 billion merger between US Airways Group and American Airlines. However, the case settled when the companies agreed to give space at major airports to LCC's. *US Airway's Merger with American Airlines Cleared for Takeoff*, 24 NO. 5 WESTLAW J. MERGERS & ACQUISITIONS 3 (2013).

[265] *See generally* Smith Jr. & Cox, *supra* note 34 (explaining the unintended consequences of blocking consolidation).

[266] *Id*.

[267] 49 U.S.C. § 47129 (2012).

[268] *See generally* Smith Jr. & Cox, *supra* note 34 (explaining the problems of federal regulation of airport rentals).

[269] *Id*.

[270] *Id*.

[271] *Id*.

However, Canada successfully implemented a privatized system in 1996, and congestion has improved.[272]

As it stands, the cost of airfare has decreased by twenty-five percent since deregulation began in 1978.[273] However, due to a multitude of factors, including rising fuel prices, the cost of flying has begun trending upward.[274] Such an increase restricts access to flight, and is slowly reversing the gains made during the age of deregulation.[275]

V. FUTURE OUTLOOK OF SPACE TOURISM AND THE POTENTIAL EXPANSION INTO A HYPERSONIC TRANSPORT INDUSTRY BASED ON CURRENT TRENDS

"Any sufficiently advanced technology is indistinguishable from magic."
- Arthur C. Clarke[276]

Because private space innovations are a fairly new phenomenon, it is difficult to predict where this incipient industry will head in the near future. However, using the progression of the private air industry as a benchmark for privatized space travel, and looking at the current trends of development in law and technology, a reasonable prognosis can be deduced.

A. Space tourism and commercial space flight in the next 10 years

In 2012, the AST, in conjunction with The Tauri Group, released a ten-year market forecast for suborbital commercial space flight.[277] The study surveyed a number of wealthy individuals and general space enthusiasts to ascertain the current and potential demand for space tourism.[278] The forecast used a baseline growth scale, which accounted for current reservations of space tourism as the control measure.[279] This baseline growth suggested demand will increase from three

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[272] *See generally* Robert P. Mark, *Canada's Private ATV System Offers Alternative for Cost-Cutting Nations*, AVIATION INT'L NEWS (Jan. 1, 2012), http://www.ainonline.com/aviation-news/aviation-international-news/2012-01-01/canadas-private-atc-system-offers-alternative-cost-cutting-nations (showing the change in Canada from government controlled air traffic to the private Nav Canada).

[273] *See* Smith Jr. & Cox, *supra* note 34.

[274] Scott Mayerowitz, *Airfares Continue to Rise, Up 12 Percent Since '09*, MIAMI HERALD, Jan. 16, 2014, http://www.miamiherald.com/2014/01/16/3875267/airfares-continue-to-rise-up-12.html (showing the trend in rising airfare despite more people flying).

[275] *See generally* Smith Jr. & Cox, *supra* note 34 (suggesting continued reduction in regulations and privatization of air traffic control will continue the gains of deregulation).

[276] *See generally Arthur C. Clarke Quotes*, BRAINY QUOTE, http://www.brainyquote.com/quotes/quotes/a/arthurccl101182.html (last visited Apr. 14, 2014) (showing Arthur C. Clarke's third law).

[277] *See* THE TAURI GROUP, SUBORBITAL REUSABLE VEHICLES: A 10-YEAR MARKET FORECAST, FED. AVIATION ADMIN. (2012), *available at* http://www.faa.gov/about/office_org/headquarters_offices/ast/media/Suborbital_Reusable_Vehicles_Report_Full.pdf.)

[278] *Id*. at 30.

[279] *Id*. at 35.

hundred thirty-five participants annually to more than four hundred by 2022.[280] Such growth means more than 3,600 individuals using suborbital space flight in the next ten years.[281] The constrained forecast, accounting for a depleted global economy, suggests total space flight participants would be over 2,000 during this same span.[282] Finally, under the study's growth scenario, the total number of space tourists balloons to over 11,000 by 2022.[283]

The forecast used the current market price for suborbital flight of between $100,000 and $200,000 to survey potential participants.[284] However, the market for space tourism becomes more elastic and desirable if the cost of flight decreases.[285] It stands to reason this price drop would in fact occur in the next ten years as the industry develops and technology continues to improve. As such, suborbital space tourism such as Virgin Galactic's SS2 will likely have between 5,000 and 12,000 consumers by 2024, and the result may be a $1 billion industry in the next ten years.[286]

The AST market forecast also posits the current commercial space industry is pioneering a potential P2P space transport industry.[287] However, the current lack of infrastructure in place for P2P transport and the lack of practical vehicle applications make suborbital P2P transport highly unlikely during the forecast's ten-year period.[288] That being said, DARPA, NASA, and companies like EADS and Hypermach are continuing to research and develop space-age hypersonic technologies to be used in the next generation of aircraft. It will be the summation of these efforts which will spur any transition from the space tourism industry to a sustainable P2P transport industry.

Additionally, NASA's role for commercial space during the next ten years will likely continue to focus on utilizing conventional launch systems constructed by private companies for use by NASA alone.[289] In this vein, NASA's ESO role will likely be to minimally advise and encourage private entrepreneurial growth as

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[280] *Id.*

[281] *Id.*

[282] *Id.*

[283] *Id.*

[284] *Id.* at 26.

[285] *Id.* at 37. This sentiment was also echoed in the Futron study conducting in 2002. *See* BEARD & STARZYK, FUTRON CORP., *supra* note 43 at 13.

[286] *See generally* Irene Klotz, *U.S. Space Tourism Set for Takeoff by 2014, FAA Says*, REUTERS, Mar. 21, 2012, http://www.reuters.com/article/2012/03/21/uk-usa-space-tourism-idUSLNE82K01420120321 (explaining FAA's 2012 prediction of space tourism in the next ten years).

[287] *See* THE TAURI GROUP, *supra* note 277 at 83.

[288] *Id.*

[289] *See* JOSEPH N. PELTON, SPACE PLANES AND SPACE TOURISM: THE INDUSTRY AND THE REGULATION OF ITS SAFETY 138, GEO. WASH. U. SACRI. RES. STUD. (2007), *available at* http://isulibrary.isunet.edu/opac/doc_num.php?explnum_id=300 (describing the differences between NASA's mission and the goals of private space companies).

NASA attempts to consolidate its base and refocus for future missions to the Moon and Mars.[290]

By Contrast, the ESA will likely refocus their effort and attempt to foster the growth of private space flight within Europe. Such, growth in Europe will likely be followed by similar growth in Asia. Growth will come in the form of deregulation, limitations on liability, and construction of infrastructure such as spaceports. All of which will pave the way for the ICAO and other international groups to revisit current air and space treaties.

Domestically, Congress will likely continue to allow the FAA to set necessary licensing and regulations for commercial space launches. As the commercial space tourism industry grows, so will the number of licensed market participants. Thus, the role of AST will continue to expand and divest more resources from the FAA to private space ventures.

B. Space Tourism and commercial space flight in the next 50 years

Lessons learned from Concorde's development and operation will help guide any future public-private endeavor to create a new method of travel. Thus, any future suborbital or hypersonic transport will need to be cost effective and burn clean fuel. Though EADS's ZEHST may not succeed in its ambitious goals, clean burning hypersonic transport may likely become a staple of the airline industry in the next fifty years. Initially, such technology would only be available at a premium. However, as more and more companies compete for a share of the hypersonic market, the price will decrease and have a positive ripple effect the travel industry as a whole.[291] Perhaps the most important thing Concorde's history can show the next generation of innovators is the benefit of pooling international resources for the greater good.

Additionally, during this timeframe, new international treaties will likely be forged supplanting the Warsaw and Chicago Conventions of old. Thus it stands to reason that during this time, launch countries will no longer be liable for the mishaps of private space actors. Additionally, new open skies agreements will be forged allowing for international access between spaceports for space travellers, and subsequently usher in P2P consumer space travel.[292]

Another issue facing the progression of the commercial space industry involves so called flags of convenience.[293] Flags of convenience are principally a maritime business practice where a merchant ship registers in a country different from that of

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[290] *See generally id.* (showing NASA's goals as venturing to the Moon and Mars).

[291] *See generally* Davies, *supra* note 36 (suggesting a return to supersonic flight would ultimately reduce the cost of travel).

[292] Open skies agreements have become increasingly popular with nations such as the United States which bring cooperation between contracting countries by eliminating must governmental restrictions on carrier routes and pricing. *Open Skies Partnerships: Expanding the Benefits of Freer Commercial Aviation*, U.S. DEPT. OF ST. (Mar. 29, 2011), http://www.state.gov/documents/organization/159559.pdf.

[293] *See generally* Adrian Taghdiri, *Flags of Convenience and the Commercial Space Industry: The Inadequacy of Current International Law to Address the Opportune Registration of Space Vehicles in Flag States*, 19 B.U. J. SCI. & TECH. L. 405 (2013) (explaining the issue of flags of convenience for future private space flight).

the ship's owner so that the merchant can avoid liability and work standards.[294] The current liability systems in place may not be adequate to handle such a problem.[295] To curtail these possible problems the international community may turn to myriad of approaches including: direct supervision and regulation; an international tribunal handling claims; or some sort of minimum insurance threshold similar to the CSLAA's scheme.[296] However, perhaps the best approach may be an International Space Agency, which could provide oversight and guidance for all international issues resulting from private space flight, and provide some form of global uniformity.[297]

Such an agency may be obtainable depending on the international climate in the far future, and the continued success of the International Space Station. The old Cold War barriers which existed in the late 1980s have begun to dissipate, and such an organization could carry out regulation and enforcement for member nations.[298]

This P2P network will almost certainly be travelled by the wealthy initially, with the first flights coming in 2025-2030 range. Perhaps the first generation of craft to utilize this form of travel will in fact be the next generation of Hypermach SonicStar type craft. Servicing this P2P network requires a new form of air traffic control which will fall onto either AST or an entirely new agency based on potential demand. Finally, as competition enters the marketplace the cost for P2P travel will decrease and open the door for the average consumer to utilize sub-orbital space travel.

IV. THE SPACE ODYSSEY: A BLUE-PRINT TO ACHIEVE SUSTAINABLE SUB-ORBITAL P2P SPACE TRAVEL REGIME FROM THE CURRENT SPACE TOURISM INDUSTRY

"The Earth is the cradle of humanity, but mankind cannot stay in the cradle forever."

- Konstantin E. Tsiolkovsky[299]

Currently, the United States is fostering a favorable environment for the growth of the space tourism industry. Based on NASA's need for alternative access to space and AST's efforts to stimulate private enterprise, it stands to reason space tourism in the United States is here to stay. Also, AST is being proactive in anticipating the next step from commercial space tourism to suborbital P2P transportation.

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[294] *See What are Flags of Convenience?*, INT'L TRANSPORT WORKERS FED'N, http://www.itfglobal.org/flags-convenience/sub-page.cfm (last visited Apr. 14, 2014). The goal of the merchant owner is to avoid unfavorable taxes, regulations, and labor laws. *Id.*

[295] *See* Taghdiri, *supra* note 293 at 426.

[296] *See generally Id*., at 426-430 (describing the three potential methods of avoiding flag of convenience issues).

[297] *See generally* Siegfried Weissner, *Public Order of the Geostationary Orbit: Blueprints for the Future*, 9 YALE J. WORLD PUB. ORD. 217, 268-269 (1982) (suggesting an International Space Agency along the lines of the International Sea-Bed Authority may be an effective tool in developing future space regimes, provided cold war barriers are eliminated).

[298] *Id*.

[299] *See Konstantin Tsiolkovsky Quotes*, BRAINY QUOTE, http://www.brainyquote.com/quotes/authors/k/konstantin_tsiolkovsky.html (last visited Apr. 7, 2014).

However, the rest of the world, and specifically Europe, is lagging behind developing a space tourism market. In order for space tourism to stabilize globally, and expand into a suborbital P2P network, there must be unanimity amongst the world's governments to commit to private space ventures.

A. Less regulation would spur innovation, and safety would be a premium for innovators looking to avoid tort liability

Space tourism is still a nascent industry, and as such, requires less governmental oversight. That is to say companies like Virgin Galactic should not have free reign to do as they see fit in order to achieve a viable market. Rather, much like a growing child, space tourism requires necessary boundaries designed to guide and encourage growth. Congress' liability cap of $500 million for the first $2 billion in potential damages resulting from a commercial space launch accident is a step in this direction. However, more deregulation is likely needed to foster continued growth. Such, deregulation should mirror the kindling air industry following the Wright brother's first flight.

There, federal intervention was minimal and mostly spent in research and development of new technologies through the National Advisory Committee for Aeronautics ("NACA").[300] NACA preceded the CAA, CAB, and NASA.[301] It wasn't until the inception of the CAA before federal regulations truly began to regulate the air industry. This meant aviation had approximately thirty years of unfettered growth before the US Government intervened. In this same way, the space tourism industry should be allowed to expand from a mere novelty to a viable P2P service.

Private companies entering the marketplace for space tourism would understand the potential risks much greater than the first airplane companies because of the years of tort litigation and reform since early flight to now. Safety of their applications would be of premier importance to private space actors due to the known risks of their activities. As such, self-regulation within the corporation will likely be adequate while the space tourism industry stabilizes.

However, outside of the current AST structure, there still should be oversight of the space tourism industry during its infancy. NASA's ESO should be restructured into an independent new version of the NACA.[302] The reformed NACA-ESO should be a conduit between companies at the forefront of producing space technologies and experts conducting valuable research into the same.[303] The result would be an unprecedented public-private venture aimed at propelling our civilization into the twenty-first century.[304] That is to say, the relationship between the new NACA-ESO

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[300] *See generally* Elizabeth Suckow, *NACA Overview*, NAT'L AERONAUTICS & SPACE ADMIN., http://history.nasa.gov/naca/overview.html (last updated Apr. 23, 2009) (describing the history of NACA beginning in 1915).

[301] *Id*.

[302] *See generally* Glenn E. Bugos & John W. Boyd, *Accelerating Entrepreneurial Space: The Case for an NACA-style Organization*, 24 Space Policy 140, 140 (2008), *available at* http://www.nasa.gov/pdf/478021main_Paper-NACA-style_2008-GlennBugos.pdf (advocating for a new NACA type organization to oversee commercial space development).

[303] *Id*. at 146.

[304] *Id*. at 147 (describing how a new NACA might work and how information would be open on the market place once developed).

and private industry should dissimilar to the development of Concorde or X-30 because this level of taxpayer commitment is unwise in today's society. Finally, it is imperative the information shared between the new NACA-ESO and private industry flows freely so as best to advance technology and prevent research overlap. The latter is counterproductive and sets progress back.

B. Regulation should come only after the hypersonic transit industry is solvent

Prior to a sustainable hypersonic suborbital P2P industry, the ICAO, and perhaps a new space arm of the United Nations, should revisit the Space Liability Treaty and establish new boundaries for private space actors. Further, the international community should achieve new forms of open skies agreements similar to the Chicago Convention, which will allow commercial space flight internationally.

Once, the space tourism industry is viable, the logical next step would be for corporations like Virgin Galactic to expand into a P2P service. Such a transition underpins the future prospects of any viable P2P transport network, but this regime still cannot exist without the necessary infrastructure in place to service the industry. However, with the advent of spaceports around the globe, it stands to reason that P2P service should have the necessary support structure in place and be obtainable in the next twenty to thirty years.

When this transition begins to take place the AST may need to become a new federal agency, similar to its current parent, the FAA, but solely regulating commercial space travel. This new AST will continue to license and regulate new carriers. More importantly the new AST will be tasked with traffic control of commercial space flights between spaceports. However, this may not be required subsuming technology advances at an accelerated rate. Under this advanced technology scenario, suborbital space planes would have the capability to use conventional airports as well as spaceports. If this were the case then suborbital craft can rely on traditional methods of egress and arrival from existing airports. Thus, there would be no immediate need for a separate AST.

C. How the industry and market should be set for consumers

A space plane regime will ensure the continued success of travel democratization. Under this P2P travel schema, conventional jet travel will still exist, albeit at a more affordable rate. Competition amongst traditional legacy carriers will spur a new generation of fuel efficient jetcraft. All the while, rates would continue to decrease because the supply of available methods of travel will increase for the consumer. Thus, while hypersonic suborbital transportation would be a niche market, at least initially, the mere availability of this jet alternative will remove most first or business classes from conventional jetlines.[305] The result would be a more affordable jet travel industry running concurrently with a luxury or business class suborbital travel industry.

In order for there to be growth of the space tourism industry and a future suborbital P2P industry, rental space for private companies at spaceports or conventional airports should not be based on reasonable rental fees determined by the Secretary of Transportation. Instead, rentals should be based on the amount of service required by each carrier. Such a scheme would allow existing airports to

[305] *See generally* Davies, *supra* note 36 (arguing the free market will drive competition and lower travel fees in a hypersonic travel age).

expand due to increased rental revenues, and allow for new air or spaceports to be constructed. As facilities expand, more carriers can enter the marketplace, which will ultimately drive the cost of travel down.[306]

Though Canada has had success and reduced fees by privatizing their air traffic control grid, such a transition is not feasible in the United States.[307] The United States air traffic grid is too large, and would require even more oversight with the implementation of a suborbital P2P transport regime.[308] However, if Canada's success is any indicator, such a privatized traffic control regime may be feasible in a smaller domain like Western Europe.

Pricing for a hypersonic suborbital flight should be based on free-market principles, and not established by a regulatory agency like CAB. Since the abolition of CAB, the air travel industry has grown exponentially.[309] For similar growth to stem from space tourism into a suborbital P2P regime, market principles must dictate fares. As such, pricing for suborbital travel should begin with a baseline at the marginal cost of transport per consumer, and increase based on supply and demand. Also, service costs should be factored into the cost of suborbital travel. Additionally, nations may need to enter into multilateral open skies agreements to guarantee competition on an international scale, which would reduce costs even more.

VII. CONCLUSION

The space tourism industry is a necessary precursor to any suborbital P2P regime. Current legislation within the United States is favorable to growing this young industry. However, technologies being developed concurrently by DARPA and NASA need to be freely shared with private space innovators like Virgin Galactic or EADS in order to bring any new travel regime to existence. Also, the free market should establish the pricing mechanisms for any future suborbital regime so as to provide for the continuing democratization of travel.

For our civilization to continue and advance, the world needs to become a smaller place. The advent of conventional air travel has slowly begun this process. A process which assures interaction between cultures and differing ideas, thus, showing man they are no different than their once distant neighbor. However, progress has seemingly stagnated and a change is needed to safeguard mankind's future. This change may be the evolution of space tourism into commercial space travel. The eyes of the world are upon the United States, and what it does in the next few years will either ensure an age of tomorrow or hinder the same indefinitely.

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[306] *See generally* Smith Jr. & Cox, *supra* note 34 (explaining the need for increased air facilities and how this will reduce cost of travel).

[307] *See generally* Mark, *supra* note 272 (explaining how fees have been reduced due to Nav Canada).

[308] The suborbital P2P travel regime would have characteristics of both air and space flight, not dissimilar to the retired space shuttle.

[309] *See generally Airline Deregulation, Revisited*, BLOOMBERG BUS. WK., Jan. 20, 2011, http://www.businessweek.com/stories/2011-01-20/airline-deregulation-revisitedbusinessweek-business-news-stock-market-and-financial-advice (showing the increase in air passengers from 207.5 million in 1974 to 721.1 million in 2010).