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In Memoriam
This volume is dedicated to the memory of

Dr. Eilene M. Galloway
1906-2009

FOREWORD

Joanne Irene Gabrynowicz[1]

This volume of the JOURNAL OF SPACE LAW includes a number of "firsts." It contains one of the first published analyses of France's first national space law. Prof. Lucien Rapp, in his article, *When France Puts Its Own Stamp on the Space Law Landscape: Comments on Law No. 2008-518 of 3 June 2008 Relative to Space Operations*, offers the reader an in-depth look at the law as well as the forces that led to it. France has been a leading spacefarer for decades but without a national space law. Prof. Rapp identifies marketing, privatization, and internationalization as specific movements that made it clear to the French State that the law was missing critical elements necessary to address important French interests, not the least of which were liability and jurisdiction. Prof. Rapp explains the procedure and substance involved in the new legislation.

Another first contained in this issue is the first published paper containing scholarship derived from the Andrew G. Haley Archive (Archive) at the University of Mississippi School of Law, National Center for Remote Sensing, Air, and Space Law (Center). The late Andrew G. Haley is widely considered to be the world's first space law practitioner. When Haley died, his son donated a large component of Haley's correspondence to the late Dr. Stephen Gorove, the founder of the JOURNAL OF SPACE LAW. These papers, along with those of Dr. Gorove, are now housed in the Center. Mr. Michael Dodge, assistant research counsel with the Center offers, *Sovereignty and the Delimitation of Airspace: A Philosophical and Historical Survey Supported by the Resources of the Andrew G. Haley Archive*. Mr. Dodge's research

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1 Joanne Irene Gabrynowicz is the Editor-in-Chief of the JOURNAL OF SPACE LAW. She is also a professor of space law and remote sensing law and the Director of the National Center for Remote Sensing, Air, and Space Law at the University of Mississippi School of Law. Prof. Gabrynowicz was the recipient of the 2001 Women in Aerospace Outstanding International Award and is a Director of the International Institute of Space Law and a member of the American Bar Association Forum on Air and Space Law.

was facilitated, in part, by his work of processing the Archive's contents for cataloging and preservation. That work, and a description of the Archive's content is the subject of a companion article, *The Andrew G. Haley Archive at the University of Mississippi School of Law, National Center for Remote Sensing, Air, and Space Law: an Introduction.* This was also authored by Mr. Dodge and was the subject of presentation made at the Third Eilene M. Galloway Symposium on Critical Issues in Space Law on December 11, 2008 in Washington, DC.

Continuing the theme of "firsts" contained in this issue is the *White Paper on the GEOSS Data Sharing Principles (White Paper).* This is the collaborative, interdisciplinary product of a number of authors, who, as participants in the Group on Earth Observations (GEO), engaged in GEO Task DA-06-01 that specified, "Invite experts to identify steps required to further the practical application of the agreed GEOSS data sharing principles. This Task will be coordinated with the Capacity Building Committee to ensure data access for Capacity Building."[2] To assure a wide distribution of the paper, the authors have agreed to another first for the JOURNAL OF SPACE LAW, and that is to issue a Creative Commons license that will allow anyone else to also publish the paper, as long they give proper attribution. The *White Paper* is also in being published in *CODATA Data Science Journal*.

First-time JOURNAL OF SPACE LAW authors Bhatt, Egan, Hurtak, Rey, and Sundahl provide a wide array of commentary and articles addressing important space law topics. In *Inspiration to Humankind from Space Law and Science in India*, Dr. Saligram Bhatt reminds the reader that, often philosophy is an important component of the law. Co-authors Dr. Matthew Jude Egan and Dr. James Hurtak propose and apply an "openness principle" to space exploration agreements in their article, *The Openness Principle in Multilateral Agreements for Space Exploration*. In his article, *Regulatory Challenges, Antitrust Hurdles, Intellectual Property Incentives, and the Collective Development of Aerospace Vehicle-Enabling Technologies and Standards:*

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[2] GEO 2007 Work Plan, *Data Management Task* DA-06-01, http://www.earthobservations.org/documents/dsp/DA-06-01.pdf (last visited May 11, 2009).

Creating an Industry Foundation, Dr. René Joseph Rey examines the commercial space transportation aspects of the "New Space" industry and the relationship between the industry's need to produce systems that will have to function within an international regulatory framework and the requirement of the vehicles to possess the robust structures and subsystems necessary for safe, reliable operations. Prof. Mark J. Sundahl also addresses the relationship between space transportation and international regulation and specifically analyzes the duty to rescue tourists travelling on private spacecraft under the Vienna Convention on the Law of Treaties[3] as well as Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies[4] and the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space.[5]

Finally—and definitely not a first—the JOURNAL OF SPACE LAW'S regular bibliography, *Aviation and Space Law: Relevant Publications,* brings the reader a wide array of new and developing law from around the world.

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[3] Vienna Convention on the Law of Treaties, May 23, 1969, 1155 U.N.T.S. 331.

[4] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205.

[5] Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, *opened for signature* Apr. 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119.

CALL FOR PAPERS

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UNIVERSITY OF MISSISSIPPI SCHOOL OF LAW

A JOURNAL DEVOTED TO SPACE LAW AND THE LEGAL PROBLEMS ARISING OUT OF HUMAN ACTIVITIES IN OUTER SPACE.

Volume 35, Number 2

The National Center for Remote Sensing, Air, and Space Law of the University of Mississippi School of Law is delighted to announce that it will publish Volume 35, issue 2 of the JOURNAL OF SPACE LAW in the second half of 2009.

Authors are invited to submit manuscripts, and accompanying abstracts, for review and possible publication in the JOURNAL OF SPACE LAW. Submission of manuscripts and abstracts via email is preferred.

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To be considered for the next issue, submissions may be received at any time. The JOURNAL OF SPACE LAW will continue to accept and review submissions on an on-going basis.

THE ANDREW G. HALEY ARCHIVE AT THE UNIVERSITY OF MISSISSIPPI SCHOOL OF LAW, NATIONAL CENTER FOR REMOTE SENSING, AIR, AND SPACE LAW: AN INTRODUCTION

Michael S. Dodge

The National Center for Remote Sensing, Air, and Space Law (Center) at the University of Mississippi School of Law houses a large portion of the work product of the world's first practicing space lawyer, the late Andrew G. Haley. This work product is being processed and preserved at the Center, and it has been organized into the Andrew G. Haley Archive. The provenance for the materials was provided by Dr. Stephen Doyle, who worked for Haley as a law clerk over a period of two summers in 1962 and 1964.[1]

The Archive was officially launched during the Second International Conference on the State of Remote Sensing Law at the University of Mississippi School of Law on January 17-18, 2008. The Archive is supplemented by a finding aid (aid) that summarizes the contents of each folder and box in the collection.[2] It is growing daily as more information and documents are processed. The aid may be utilized by accessing the Archival webpage at http://www.spacelaw.olemiss.edu/archive/haleyarchive.htm.

The importance of the documents contained in the Archive can be appreciated by examining Haley's extensive correspondence with numerous legal scholars, academics, politicians, and U.S. Military personnel. Haley corresponded with individuals

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[1] *See* Stephen Doyle, *Introduction to The Andrew Gallagher Haley Collection at The National Center for Remote Sensing, Air, and Space Law* (Sept. 2007), *available at* http://www.spacelaw.olemiss.edu/archive/pdfs/AG%20Haley%20Collection%20expV3.pdf [hereinafter *Introduction*].

[2] The Andrew G. Haley Finding Aid, *available at* http://www.spacelaw.olemiss.edu/archive/haleyarchive.htm (last visited Mar. 18, 2009).

such as Arthur C. Clarke, Myers S. McDougal, Philip Jessup, Eilene Galloway, Hubert H. Humphrey, Gerald R. Ford, Lyndon B. Johnson, John F. Kennedy, Earl Warren, and others.[3] The letters and signatures of these historic persons have been preserved in their pristine condition.

The Archive contains a variety of early space law materials in many languages. Documents have been discovered in English, French, Spanish, Russian, Italian, Portuguese, German, and other languages.[4] Many of these materials are personal correspondence between Haley and his colleagues and friends throughout the world. Some of these documents cover issues during the early years of the American Institute of Astronautics and Aeronautics (AIAA), the Committee on Space Law of the American Bar Association, the International Astronautical Federation (IAF), International Institute of Space Law (IISL), and the International Academy of Astronautics (IAA).[5] The Archive also contains, among other materials, drafts of books Haley wrote on space law, IISL papers written by attorneys from around the world, news articles, conference documents and correspondence.

Selected documents were presented at The Third Eilene M. Galloway Symposium on Critical Issues in Space Law at the Cosmos Club in Washington D.C., December 11, 2008.[6] These documents represented a sampling of the variety of information contained within the Archive. Some examples are:

1) Correspondence between Haley and Arthur C. Clarke, including a letter in which Clarke discusses telecommunications, remote sensing, Global Positioning System (GPS), and other applications of geosynchronous orbit. Clarke concludes the letter by noting, "I'll get on with my science fiction, and wait to say 'I told you so!'"[7]

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[3] The Andrew G. Haley Archive Presentation (Jan. 17 – 18, 2009), *available at* http://www.spacelaw.olemiss.edu/activitiesandevents/2008/galloway%20presentations%20pdf/3rd%20Galloway%20-%20Dodge.pdf [hereinafter Haley Presentation].

[4] *Id.*

[5] *Introduction*, *supra* note 1.

[6] Haley Presentation, *supra* note 3.

[7] Letter from Arthur C. Clarke to Andrew Haley (Aug. 1956), *available at* http://rescommunis.files.wordpress.com/2008/03/clarkeletter2-1.jpg.

2) Correspondence between Haley and the Chief Justice on the United States Supreme Court, Earl Warren.[8] In their discussion, Haley requested the use of the Supreme Court Conference Rooms for the International Institute of Space Law's Fourth Colloquium on the Law of Outer Space, and Haley encloses information informing Warren about the purpose and accomplishments of the Colloquium. Warren informed Haley that it would not be possible to use the rooms, noting that "[w]e never know when our conference rooms might be needed for the Court itself and for meetings of the Judicial Conference of the United States."[9]

3) Correspondence between Haley and the American Bar Association (ABA), in which the ABA informs Haley that he has been reappointed to the Committee on Space Law by the Chair of the Section on International and Comparative Law.[10]

4) Documents describing the formative period of space law and the IISL, including a description of Haley's involvement as founder of the organization.[11]

5) Appearance and Comments of the American Rocket Society before the Federal Communications Commission concerning a statutory inquiry into the allocation of frequencies to the various non-governmental services in the radio spectrum between 25 mcs and 890 mcs. Haley noted that "this is an actual space law proceeding—probably the first."[12]

6) Correspondence concerning the delimitation of air and space, a topic early space lawyers considered of the utmost importance. The Archive includes comments by many individuals on this matter, and there are materials which note the formation of a Working Group under the ambit of the International Institute of Space Law to consider the delimitation issue.[13]

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[8] Letter from Andrew Haley, General Counsel to the International Astronautical Federation, to Earl Warren, Chief Justice United States Supreme Court (Jan. 28, 1968), *available at* http://www.spacelaw.olemiss.edu/archive/haleyarchive.htm.

[9] Letter from Earl Warren, Chief Justice United States Supreme Court, to Andrew Haley, General Counsel to the International Astronautical Federation (Feb. 13, 1961), *available at* http://www.spacelaw.olemiss.edu/archive/haleyarchive.htm.

[10] Haley Presentation, *supra* note 3.

[11] *Id.*

[12] *Id.*

[13] *Id.*

7) Correspondence evidencing the Cold War tensions of the era, including attempts by the U.S. Federal Bar Association of New York, New Jersey, and Connecticut to begin a discussion with lawyers from the U.S.S.R. on the merits of "Democracy under Capitalism versus Communism."[14]

In addition to the above, the Archive contains more documents from a multitude of individuals covering many issues on aerospace law. The National Center for Remote Sensing, Air, and Space Law continues to process the Archive, and the material is made available online at the Center's blog, Res Communis,[15] as the finding aid is expanded. Select PDF images of important space law documents will be accessible in the near future. It is the belief of the Center that the Archive will provide an invaluable resource for aerospace attorneys and academics, as well as historians.

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[14] Letter from William Hyman, Chairman, Special Committee for the Promotion of the Ideals of Democracy, to Ministry of Justice, Moscow, Union of Soviet Socialist Republics (Nov. 11, 1959), *available at* http://www.spacelaw.olemiss.edu/archive/haleyarchive.htm.

[15] The University of Mississippi School of Law, *Res Communis, A blog on the legal aspects of human activities using aerospace technologies*, *available at* http://rescommunis.wordpress.com/ (last visited Mar. 18, 2009).

SOVEREIGNTY AND THE DELIMITATION OF AIRSPACE: A PHILOSOPHICAL AND HISTORICAL SURVEY SUPPORTED BY THE RESOURCES OF THE ANDREW G. HALEY ARCHIVE

Michael S. Dodge[*]

The airplane is indeed the architect of a changing world.[1]

INTRODUCTION

Over the past century, the law of the air has come into its own. Like many fields before it, air law has established itself as a legal necessity. Though humanity has only been flying for slightly over a century, the law has wasted no time in asserting itself. Indeed, multiple extant treaties cover everything from public[2] to private[3] air law. Topics ranging from concerns over security[4] to liability[5] for third parties damaged on the ground have been covered by the air treaty regime. It is incontroverti-

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[*] Mr. Dodge is an Assistant Research Counsel at the National Center for Remote Sensing, Air, and Space Law, and a member of the Mississippi Bar. He earned his J.D. from the University of Mississippi School of Law, and worked as a research assistant and intern with the Center while completing his coursework. Mr. Dodge helped research the legal regimes of foreign nation-states for a study for the U.S. Dept. of Commerce/NOAA that culminated in a Center article entitled: *The Land Remote Sensing Laws and Policies of National Governments: A Global Survey*. With fellow participant Eric McAdamis, he placed second in the North American Regionals of the 2007 Manfred Lachs Space Law Moot Court Competition at Georgetown University Law Center in Washington D.C. Currently, Mr. Dodge is processing the Andrew G. Haley Archive.

[1] Charles S. Rhyne, *International Law and Air Transportation*, 47 MICH. L. REV. 41 (1948).

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

[3] International Convention for the Unification of Certain Rules Relating to International Carriage by Air, Oct. 12, 1929, 49 Stat. 3000, 137 L.N.T.S. 11 [hereinafter Warsaw Convention].

[4] Paris Convention for the Regulation of Aerial Navigation, Oct. 13, 1919, 11 L.N.T.S. 173 [hereinafter Paris Convention].

[5] Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface, Oct. 7, 1952, ICAO Doc. 7364, 310 U.N.T.S. 181 [hereinafter Rome Convention].

ble that air law has established a foothold over humankind's activities in the air. However, as with most areas of law, the arena of air law is not free from cases and controversies. This essay attempts to identify the background of modern air law, and it also seeks to posit problems yet to be solved. In particular, the concepts of sovereignty and jurisdiction become problematical when applied to the delimitation of airspace. Succinctly put, what is the airspace, and where does it end? Had such a question been proposed to early air lawyers, it would probably have been perceived as pointless. After all, in those early years, most of humanity probably possessed no realistic vision of humankind reaching space. Now, a unique field of law has emerged to cover human space activities.[6] The space age has caused humanity to reflect on its role in the universe in general, and in the air and space adjacent to our planet in particular. This essay intends to analyze a sampling of the theories and arguments proposed for determining where and, more forthrightly, *if* a demarcation between air and space exists.

Furthermore, this line is something of a Holy Grail to air and space lawyers, and no unified opinion has emerged to date. Although concern for the need to delimit the boundary between air and space has existed since the early days of space law,[7] the topic remains relevant to the modern world of international law. A recent questionnaire by the United Nations Committee on the Peaceful Uses of Outer Space sought the opinions of Member States regarding whether there was a need to define space and

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[6] *See* Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty]; *see also*, Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space, Apr. 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119; Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187; Convention on Registration of Objects Launched into Outer Space Nov. 12, 1974, 28 U.S.T. 695, 1023 U.N.T.S. 15.

[7] *See* Letter from Andrew Haley, President, International Astronautical Federation, to Jakob Ackeret, Federal Institute of Technology (Switzerland) (Apr. 1, 1958) (available through the Andrew G. Haley Archive, *available at* http://www.spacelaw.olemiss.edu/archive/haleyarchive.htm); Andrew G. Haley, *Space Age Presents Immediate Legal Problems*, *in* PROCEEDINGS, FIRST COLLOQUIUM ON THE LAW OF OUTER SPACE 7 (IISL, 1958).

delimit airspace and outer space.[8] The responses were almost uniformly affirmative, with Belarus noting that positive aspects of such delimitation would include increased efficiency in the control of flights in both airspace and outer space, and noting the decreased risk to participants in air and space travel.[9] The Kingdom of Jordan explained its interest in the delimitation issue, noting that "[t]he non-definition of outer space will result in ambiguity in the relevant laws and conventions. Moreover, the delimitation of outer space will be useful for the concept of national sovereignty, placing States on an equal footing before international law."[10] This controversy will continue until lawyers can be certain which law applies where. Thus, this essay suggests that humanity should renew its efforts to determine where air ends, and space begins.

This essay explores the concept of sovereignty in several parts. First, the history of sovereignty *qua* sovereignty is examined. Secondly, sovereignty and airspace is discussed. Next, the concept of airspace as viewed from a sovereign regime is analyzed. Finally, some background on the Outer Space Treaty regime's solution to sovereignty problems is discussed to provide a contrasting template from which the difficulties of delimitating airspace may be viewed.

Sovereignty

A. The Past, and Present

Before a thorough analysis of sovereignty can be undertaken, a summation of the history and concept of sovereignty must first be proffered. Questions to ask would include: what is sovereignty?; from whence did it come?; how is it seen traditionally?; and, finally, how is it seen under the light of changes in international law brought about by the adoption of the air trea-

[8] U.N. Comm. on the Peaceful Uses of Outer Space [COPUOS], Note by the Secretariat, Addendum, *Questions on the Definition and Delimitation of Outer Space: Replies from Member States,* ¶¶ 1-3, U.N. Doc. A/AC.105/889/Add.1 (Jan. 21, 2008), *available at* http://www.unoosa.org/pdf/reports/ac105/AC105_889Add1E.pdf.

[9] *Id.* at ¶ 5.

[10] *Id.* at ¶ 11.

ties and the Outer Space Treaty? To answer these questions, one must delve into a subject claimed by both philosophy and history, hoping in the process to glean sufficient understanding of the subject to elucidate it properly.

The first question is that of definitional sovereignty. Today, sovereignty can be defined in several ways, but the most prominent is the aspect of total or superior control over a territory. Because of the recent effects of globalization and the shrinking size of the world due to technological—and in particular, communication—improvements, what sovereignty really is remains somewhat debatable. Some scholars refuse to allow for a definition at all.[11]

> But there is in fact a definition that captures what sovereignty came to mean in early modern Europe and of which most subsequent definitions are a variant: *supreme authority within a territory*. This is the quality that early modern states possessed, but which popes, emperors, kings, bishops, and most nobles and vassals during the Middle Ages lacked.[12]

Black's Law Dictionary defines it as "1. Supreme dominion, authority, or rule; 2. The supreme political authority of an independent state; 3. The state itself."[13] So the traditional concept of sovereignty is that power over a state or territory that makes a Nation-State supreme. Thus, France is the sovereign over all French territory. French ministers make the decisions regarding important occasions in the territory—not Italians, Chinese, or Americans.

The question remains as to how this concept developed, as well as whether it can, in its current form, adapt to cover air law and outer space exploration and the treaties governing such activity. The most common explanation is that sovereignty acquired its current meaning after the bloody wars of religion known as the Thirty Years War.[14] It is true that Nation-States

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[11] Dan Philpott, *Sovereignty*, *in* STANFORD ENCYCLOPEDIA OF PHILOSOPHY (2003), http://plato.stanford.edu/entries/sovereignty/.

[12] *Id.*

[13] BLACK'S LAW DICTIONARY 1430 (8th ed. 2004).

[14] Philpott, *supra* note 11.

were not always the wielders of sovereign power.[15] The result of the Thirty Years War was the signing of the peace accords at Westphalia.[16] However, the War did not account for a miraculous, instant Nation-State solution—indeed:

> What features of Westphalia make it the origin of the sovereign states system? In fact, not all scholars agree that it deserves this status.[17] Nowhere in the settlement's treaties is a sovereign states system or even the state as the reigning legitimate unit, prescribed. Certainly, Westphalia did not create a sovereign states system *ex nihilo*, for components of the system had been accumulating for centuries up to the settlement; afterwards, some medieval anomalies persisted. In two broad respects, though, in both legal prerogatives and practical powers, the system of sovereign states triumphed. First, states emerged as virtually the sole form of substantive constitutional authority in Europe, their authority no longer seriously challenged by the Holy Roman Empire. The Netherlands and Switzerland gained uncontested sovereignty, the German states of the Holy Roman Empire accrued the right to ally outside the empire, while both the diplomatic communications and foreign policy designs of contemporary great powers revealed a common understanding of a system of sovereign states. The temporal powers of the Church were also curtailed to the point that they no longer challenged any state's sovereignty. In reaction, Pope Innocent X condemned the treaties of the peace as "null, void, invalid, iniquitous, unjust, damnable, reprobate, inane, empty of meaning and effect for all time[18]."[19]

Thus, the separation from the Church was not friendly. However, it was also not unexpected. The Church had undergone tumultuous changes with varying popes, and the notions of temporal power versus eternal power came into play. The for-

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[15] Jonathan F. Galloway, *Limits to Sovereignty: Antarctica Outer Space and the Sea Bed*, *in* PROCEEDINGS, FORTY-FIRST COLLOQUIUM ON THE LAW OF OUTER SPACE, 81 (IISL, 1998).

[16] *Id.*

[17] STEPHEN D. KRASNER, SOVEREIGNTY: ORGANIZED HYPOCRISY (Princeton, NJ: Princeton University Press, 1999).

[18] Innocent X, *quoted in* DAVID MALAND, EUROPE IN THE SEVENTEENTH CENTURY 16 (Macmillan 1966).

[19] Philpott, *supra* note 11.

mer is the concept of sovereignty as it is traditionally defined, whereas the latter is the idea that the Church has the power to "bind and loose," if you will. The concept of sovereignty became solid after the Treaty of Westphalia. However, there are indications that the precepts of sovereignty were extant long before that time. A conflict between the Catholic Church and the Holy Roman Emperors of the medieval period had existed for centuries, and the idea of statehood began to flower during that time.[20] "The new states that were emerging in the thirteenth century were the kingdoms of national rulers, each of whom claimed to be 'an emperor unto his own realm' and recognized no external superior in temporal affairs."[21] Primarily, what the world began to lose was the idea that a king (or a Pope) ruled by authority of Divinity itself, or the Divine Right. That idea is an ancient and well understood one, but even more modern chroniclers have described it with some force. For example, Shakespeare wrote of the concept in *Richard II*:

> Not all the water in the rough rude sea
> Can wash the balm off from an anointed king.
> The breath of worldly men cannot depose
> The deputy elected by the Lord.
> For every man that Bolingbroke hath pressed
> To lift shrewd steel against our golden crown,
> God for his Richard hath in heavenly pay
> A glorious angel. Then, if angels fight,
> Weak men must fall; for heaven still guards the right.[22]

It is hardly surprising then that papal leaders would balk at the notion of Nation-States grasping temporal power on their own. Long before Westphalia, notions crept up that the papal states could not be ruler of all the Earth. For example, the struggle for power between church and state began to heat up in the mid-twelfth century. Although the general power structure did not seem to change much per se, the *appearance* of where power came from once again became a prevalent talking point.

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[20] BRIAN TIERNEY, THE CRISIS OF CHURCH AND STATE 159 (1998).
[21] *Id.*
[22] WILLIAM SHAKESPEARE, RICHARD II act 3, sc. 2.

Most interesting to this author was the debacle between Holy Roman Emperor Frederick Barbarossa and Pope Hadrian (or, more specifically, between the Emperor and the bureaucracy of Rome). The most intriguing aspect of the story is the overtly political nature of the fight.

The concepts of temporal and spiritual power once more took center stage when Frederick declined to accede to typical Holy Roman Emperor etiquette during his first meeting at Rome (in refusing to help the Pope get into his saddle).[23] That Frederick publicly insulted the "Senate" of Rome after they insinuated his power came as a gift from them was no balm to the already tense situation.[24] Five years later, the issue had still not been put to bed, and came to a head at the Diet of Besancon.[25] The fire began anew with the use of the word *beneficium* in a letter written to the Emperor by the Pope's chancellor, since that word has two or more official meanings. On the one hand, the word can mean benefit. On the other, it can mean gift (as in when someone "benefits" another by bequeathing money, lands, or power). The first meaning could be a cordial recognition of proper imperial power, but the second would mean that the papacy, if it was to be truly represented by the letter, was exerting temporal power by claiming that power on Earth was its alone to give. This exercise is reminiscent of the battle over the exact meaning of the words of Article II.[26] What does it mean to "appropriate" or engage in "a claim of sovereignty"? These questions will be explored further in the essay. The Emperor took the latter meaning as what was conveyed by the chancellor.[27] The Emperor wrote of the Papal delegation that they:

> [B]y lofty pride, by arrogant disdain, by execrable haughtiness, presented a message in the form of a letter from the pope, the content of which was to the effect that we ought always to remember the fact that the lord pope had bestowed upon us the

[23] TIERNEY, *supra* note 20, at 100.
[24] *Id.*
[25] *Id.*
[26] The relevant language here is "[o]uter space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means." Outer Space Treaty, *supra* note 6, at art. II.
[27] TIERNEY, *supra* note 20, at 100.

> imperial crown and would not even regret it if Our Excellency had received greater benefits [*beneficia*] from him.[28]

The situation had the potential to become quite disastrous, but the words of the pope quelled any potential violence when he wrote to Frederick to inform him that the word *beneficia* meant only benefit, and not something that implied Frederick "owed" the pope for the former's power.[29] However, the chancellor could have corrected the misunderstanding after the issue had become a hot topic, rather than waiting for it to get so explosive that the pope himself had to intervene.[30] What the real meaning behind those words is remains to be debated. What is certain is that the issue of the Church's power over politics once again became a point of contention between church and "state" during the mid-twelfth century, raising the problems of who is sovereign over what.

Such an emphasis on individual States could create chaos and dissention among mankind, where before the Church could more easily silence its opponents in generally peaceful ways. This argument could be used for the Outer Space Treaty regime as well. Nation-States have become accustomed to their power, but it is possible that mankind's extension into space will change the viewpoint of sovereignty altogether. Some argue that "perhaps it is becoming more and more a legal fiction endangered by independence, integration, globalism and a world without borders."[31] The discussion above on what today might seem minor incidents created political dangers so great that war was not out of the question. In modern times, one idea of going into space was surely that of peaceful coexistence. After all, space was supposed to be the "province of all mankind."[32] The Outer Space Treaty was designed to promote such peace in accordance with the principles of the United Nations.[33]

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28 *Id.* at 107.
29 *Id.* at 100-01.
30 *Id.*
31 J. ANN TICKNER, GENDER IN INTERNATIONAL RELATIONS: FEMINIST PERSPECTIVES ON ACHIEVING GLOBAL SECURITY 18, 64, 81, 117 (New York: Columbia University Press, 1992), *quoted in* Galloway, *supra* note 15.
32 Outer Space Treaty, *supra* note 6, at art. I.
33 *Id.* at Preamble.

Whatever may be the future for sovereignty on Earth, the outer space treaty regime was written with the Westphalian system in place. This is understandable, because although entering into the realm of space was a new endeavor for all humankind, the United Nations Charter provided the basis for the regime. Specifically, Article 2(4) states "All Members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in any other manner inconsistent with the Purposes of the United Nations,"[34] and Article 2(7) states:

INSPIRED by the great prospects opening up before mankind as a result of man's entry into outer space,

RECOGNIZING the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes,

BELIEVING that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development,

DESIRING to contribute to broad international co-operation in the scientific as well as the legal aspects of the exploration and use of outer space for peaceful purposes,

BELIEVING that such co-operation will contribute to the development of mutual understanding and to the strengthening of friendly relations between States and peoples,

RECALLING resolution 1962 (XVIII), entitled "Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space", which was adopted unanimously by the United Nations General Assembly on 13 December 1963,

RECALLING resolution 1884 (XVIII), calling upon States to refrain from placing in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction or from installing such weapons on celestial bodies, which was adopted unanimously by the United Nations General Assembly on 17 October 1963,

TAKING account of United Nations General Assembly resolution 110 (II) of 3 November 1947, which condemned propaganda designed or likely to provoke or encourage any threat to the peace, breach of the peace or act of aggression, and considering that the aforementioned resolution is applicable to outer space,

CONVINCED that a Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, will further the Purposes and Principles of the Charter of the United Nations . . . .

[34] U.N. Charter art. 2, para. 4.

> Nothing contained in the present Charter shall authorize the United Nations to intervene in matters which are essentially within the domestic jurisdiction of any state or shall require the Members to submit such matters to settlement under the present Charter; but this principle shall not prejudice the application of enforcement measures under Chapter VII.[35]

These measures indicate that the nation-states involved in the creation of the United Nations believed it important to keep control of typical sovereign schemes, rather than create a world government with absolute control over all territories on Earth. The function of the United Nations, in simplistic terms, is to encourage peace—not to strong-arm governments into the asserted goals of all by some military means. The question remains, however, as to how sovereignty is viewed in space as a result of Article II of the Outer Space Treaty. Before the author provides an answer, a brief look at the controversy surrounding the delimitation of space must be explored, for it relays the Nation-State centered emphasis on sovereignty as the one of the most pertinent factors in the construction of behavioral norms for outer space.

B. Sovereignty and the Air

The doctrine of absolute sovereignty is considered entrenched in international law.[36] Indeed, sovereignty has been written into some of the most exceptionally important air law treaties. In particular, the Paris Convention and the Chicago Convention make obvious the fact that Westphalian sovereignty has a place in the world of aviation. The skies may have opened up to technology, but they have not freed themselves from law. Nor has humankind labored under the delusion that air should be open to all, and sovereignty ignored altogether, as with the *res communis* ideal applicable to outer space.

The Paris Convention, convened shortly after the horrendous events of the First World War, set principles regarding the

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[35] *Id.* at art. 2, para. 7.

[36] *See* John C. Cooper, *Air Transport and World Organization*, 55 YALE L. J. 1190, 1195 (1946); Rhyne, *supra* note 1, at 43.

right of Nation-States over their air territory. The first few articles are reproduced below:

CHAPTER I.
GENERAL PRINCIPLES.

Article 1.

The High Contracting Parties recognise that every Power has complete and exclusive sovereignty over the air space above its territory.

For the purpose of the present Convention, the territory of a State shall be understood as including the national territory, both that of the mother country and of the colonies, and the territorial waters adjacent thereto.

Article 2.

Each contracting State undertakes in time of peace to accord freedom of innocent passage above its territory to the aircraft of the other contracting States, provided that the conditions laid down in the present Convention are observed.

Regulations made by a contracting State as to the admission over its territory of the aircraft of the other contracting States shall be applied without distinction of nationality.

Article 3.

Each contracting State is entitled for military reasons or in the interest of public safety to prohibit the aircraft of the other contracting States, under the penalties provided by its legislation and subject to no distinction being made in this respect between its private aircraft and those of the other contracting States from flying over certain areas of its territory.

In that case the locality and the extent of the prohibited areas shall be published and notified beforehand to the other contracting States.

Article 4.

Every aircraft which finds itself above a prohibited area shall, as soon as aware of the fact, give the signal of distress provided in paragraph 17 of Annex D and land as soon as possible

> outside the prohibited area at one of the nearest aerodromes of the State unlawfully flown over.[37]

Thus, one of the greatest achievements in air law indicates that the lessons of the militarization of airspace in the War to End All Wars had not been forgotten. "The Paris convention was an outgrowth of World War I and, in the opinion of some it was an undesirable and unwise agreement because it reflected wartime philosophy."[38] Albert Roper noted that the Convention, even when not signed by certain Nation-States, had the unfortunate effect of suppressing the freedom of the air, all due to the "terrible lessons of the war."[39] This chagrin was primarily a facet of the idea that air should be free to all for all non-military purposes, and was particularly espoused by the early air law document known as the Fauchille proposal.[40] Though the air would be presumed free for commercial purposes, it was not necessarily free for military aircraft when they might be forbidden due to national security.[41] The Fauchille proposal intimated a desire to allow humankind unprecedented freedom of movement and commerce. Unfortunately, the outbreak of World War I shocked humanity into the realization that aircraft could be used as deadly implements of war. Thus, the Paris Convention took heed of lessons learned, and allowed Nation-States to maintain absolute sovereignty over their airspace.

Even before World War I, confrontations between Nation-States indicated that no matter what the view taken by the Fauchille report, sovereignty was presumed in the airspace above defined territory. On several occasions, The Netherlands protested that German aircraft dared to cross into their territory.[42] As a neutral state, The Netherlands believed it had the right to shoot at any aircraft passing over its territory, even if

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37 Paris Convention, *supra* note 4, arts. I-IV.

38 ANDREW G. HALEY, SPACE LAW AND GOVERNMENT 46 (1963).

39 Albert Roper, *Recent Developments in International Aeronautical Law*, 1 J. AIR L. 395, 405-06 (1930).

40 HALEY, *supra* note 38, at 42.

41 21 ANNUAIRE DE L'INSTITUT DE DROIT INTERNATIONAL 293, 295 (1906) (translation).

42 *See* HALEY, *supra* note 38, at 43-45.

the aircraft was there by mistake.[43] Moreover, The Netherlands exercised this right by attacking a German zeppelin that, under *force majeure*, had inadvertently drifted into the former's territory.[44] The Netherlands' Ministry of Foreign Affairs justified the decision to shoot at the German aircraft, noting:

> In the interest of the defense of the state no less than in the view of the maintenance of a strict neutrality a neutral power therefore has the right to oppose forcibly all passage of its frontiers by belligerent airships unless they should indicate by a signal—white flag or other distinctive sign—their intention to land. Considerations of humanity may lead the authorities to resort to force only after having tried to warn the aviator that he is above neutral territory, but in view of the forgoing such notice is not obligatory.[45]

After this event, Germany and The Netherlands adopted a distress system.[46] Unfortunately, the events of World War I did nothing to alleviate the fear that Nation-States had concerning the misuse of their airspace. After the events of that war, the notion of absolute sovereignty conveyed by the Paris Convention became adopted by most Nation-States, and the effect of its provisions has not changed much since that time.[47]

Shortly after World War II, the public international law was further developed. The Chicago Convention established the International Civil Aviation Organization (ICAO), and is considered one of the most significant air law instruments to date.[48] Like the Paris Convention before it, the Chicago Convention was not shy regarding sovereignty. The first article noted that "[t]he contracting states realize that every state has complete and exclusive sovereignty over the airspace above its territory,"[49] thereby mirroring the Paris Convention's first article.

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[43] *Id.* at 44.
[44] *Id.*
[45] Netherlands, Ministry of Foreign Affairs, Recueil De Diverses Communications Du Ministre Des Affairs Etrangeres Aux Etats-Generaux Par Rapport A La Neutalite Des Pays-Bas Et Au Respect Du Droit Des Gens 142-43 (1916) (translation).
[46] HALEY, *supra* note 38, at 45.
[47] *Id.* at 46.
[48] Chicago Convention, *supra* note 2.
[49] *Id.* at art. I.

Furthermore, the Chicago Convention provides that each Nation-State can withhold passage through airspace from other Nation-States, noting:

> (a) Each contracting State may, for reasons of military necessity or public safety, restrict or prohibit uniformly the aircraft of other States from flying over certain areas of its territory, provided that no distinction in this respect is made between the aircraft of the State whose territory is involved, engaged in international scheduled airline services, and the aircraft of the other contracting States likewise engaged. Such prohibited areas shall be of reasonable extent and location so as not to interfere unnecessarily with air navigation. Descriptions of such prohibited areas in the territory of a contracting State, as well as any subsequent alterations therein, shall be communicated as soon as possible to the other contracting States and to the International Civil Aviation Organization.
>
> (b) Each contracting State reserves also the right, in exceptional circumstances or during a period of emergency, or in the interest of public safety, and with immediate effect, temporarily to restrict or prohibit flying over the whole or any part of its territory, on condition that such restriction or prohibition shall be applicable without distinction of nationality to aircraft of all other States.
>
> (c) Each contracting State, under such regulations as it may prescribe, may require any aircraft entering the areas contemplated in subparagraphs (a) or (b) above to effect a landing as soon as practicable thereafter at some designated airport within its territory.[50]

Thus, the Chicago convention was fully prepared to allow Nation-States to maintain their supremacy over their own airspace, so long as they maintained it indiscriminately. Perhaps the most striking example of provision (b), as cited above, is what happened after the events of 9/11. After the brutal terrorist attack of 9/11, there was real concern that more planes could be diverted for terroristic purposes, and the Federal Aviation Administration decided to land all planes within the airspace of

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50 *Id.* at art. IX.

the United States.[51] Like The Netherlands before, the United States quickly utilized the dominion it possessed over its airspace to secure its territory.

Intriguingly, the sovereignty protected by the Paris and Chicago Conventions seems to be the modern day extension of a Roman and Common Law right, *cujus est solum, ejus est usque ad coelum*. Various translations have been provided for this oft utilized concept. It may be translated, "he who has the soil owns upward into heaven,"[52] "whose is the soil, his it is up to the sky,"[53] or, this author's favorite, "[h]e who owns the soil owns up into the sky and (down below) to hell!"[54] This author's rough translation is "he who owns the soil owns also everything above and below."

Though in olden times this right was meant to be applicable to the individual, in the era of internationalization and globalization, Nation-States have taken on a legal individuality, and thereby claimed the right for themselves. The importance of the right is derived from the fact that this simple maxim expresses how humans have thought for thousands of years about ownership of airspace. Furthermore, the effects of the maxim on the modern law are obvious and profound. The wording of the Paris Treaty and the language of the Chicago Convention both serve to illustrate that the ancient maxim was still the predominant legal analysis of airspace.

One should not forget that although the maxim has been extended to the arena of Nation-States' right to the airspace above their territory, it originally did not apply so expansively. In fact, it originally served to protect a Roman land owner's air and light rights.[55] The right received further treatment by Ac-

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[51] *See, e.g.* Marilyn Adams, Alan Levin & Blake Morrison, *Part II. No One was Sure if Hijackers were on Board*, USA TODAY, http://www.usatoday.com/news/sept11/2002-08-12-hijacker-daytwo_x.htm.

[52] Jean-Marie Henckaerts, *Vexing Issues of Supreme Authority and Sovereign Rights Arising from Space Activities*, 88 AM. SOC'Y INT'L L. PROC. 259, 262 (1994).

[53] HALEY, *supra* note 38, at 41.

[54] F. B. Schick, *Who Rules the Skies: Some Political and Legal Problems of the Space Age*, INTERNATIONAL STUDY PAPER NO. 4, INSTITUTE OF INTERNATIONAL STUDIES, UNIV. OF UTAH, 4 (1961).

[55] *Id.*; *see also*, *Digest*, VIII.2.24.

cursius, a Glossator of the Bolognese school around 1200 A.D.[56] Accursius had a son who went to study law with the court of Edward I, and it is possible that this is how the maxim first became introduced into the common law system.[57]

It is possible that the maxim arose from a document executed during the reign of Edward I and attached to the so-called Charter to the Jews.[58] Thus, though typically attributed to the Romans, the maxim may in fact have a Jewish origin as well.[59] It is not known whether the Jewish possibility is independent of Roman influence, or if it too can be traced to Roman times.

Whatever may be the origin of *cujus est solum*, its inclusion into the modern world was guaranteed by English decisions that effectively cemented the maxim into the common law. Lord Coke was instrumental in this process, noting in one case that it is foolish to consider a property owner's airspace as anything less than his to do with what he pleases:

> Case for stopping of his light.—It was agreed by all the justices, that if two men be owners of two parcels of land adjoining, and one of them doth build a house upon his land, and makes windows and lights looking into the other's lands, and this house and the lights have continued by the space of thirty or forty years, yet the other may upon his own land and soil lawfully erect an house or other thing against the said lights and windows, and the other can have no action; for it was folly to build his house so near to the other's land: and it was adjudged accordingly. *Nota. Cujus est solum, ejus est summitas usque ad coelum. Temp. Ed. 1.*[60]

Finally, Lord Coke solidified this sentiment with his opinion that "the earth hath in law a great extent upwards, not only of water as hath been said, but of aire, and all other things even up to heaven, for *cujus est solum ejus est usque ad coelum*, as it is holden."[61] The doctrine continued in the United States' legal

[56] Schick, *supra* note 54, at 5.
[57] *Id.*
[58] *Id.* at 5-6.
[59] *Id.* at 6.
[60] Bury v. Pope, 78 Eng. Rep. 375 (1586).
[61] Lord Coke, *cited in* Schick, *supra* note 54, at 6.

system as an outgrowth of the English system. In one case, *Guille v. Swan*, 19 Johns 381 (1822), defendant balloonist descended from the air above another's property and landed, thereby causing damage to the garden of the plaintiff.[62] Defendant's violation of the plaintiff's airspace caused a crowd to enter into the garden to assist the former, which resulted in further destruction.[63] The defendant was liable for the damage caused.[64]

Despite its prevalence in the common law, the maxim did not enjoy unlimited application. In *United States v. Causby*, 328 U.S. 256 (1946), a chicken farmer claimed his property had been taken under the meaning of the U.S. Constitution's Fifth Amendment.[65] Military aircraft had been flying low over the plaintiff's property, thereby scaring some of his poultry to death.[66] The Court held that in fact such actions did constitute a taking when they prevented an owner from the full use and enjoyment of his property.[67] However, the *cujus est solum* maxim was not the justification for protecting the plaintiff's property. Indeed, "[i]t is ancient doctrine that at common law ownership of the land extended to the periphery of the universe – *Cujus est solum ejus est usque ad coelum*. But that doctrine has no place in the modern world."[68]

Causby may have attempted to limit the principle, but it did not get rid of it entirely. In fact, *Causby* served to transfer the focus of the maxim from the individual human to the individual Nation-State. Of course, this had already been recognized in the language of the Paris and Chicago instruments, but it was solidified at the national level by *Causby*. Moreover, despite the language in *Causby* to the contrary, *cujus est solum* continues to enjoy favorable treatment in legislation.[69] The Federal Aviation Act of 1958, passed not long after *Causby*, noted:

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[62] Guille v. Swan, 19 Johns 381 (1822).
[63] *Id.* at 383.
[64] *Id.*
[65] United States v. Causby, 328 U.S. 256 (1946).
[66] *Id.* at 259.
[67] *Id.* at 261.
[68] *Id.* at 260-61.
[69] Schick, *supra* note 54, at 6.

> The United States of America is declared to possess and exercise complete and exclusive national sovereignty in the airspace of the United States, including airspace above all inland waters and the airspace above those portions of the adjacent marginal high seas, bays and lakes, over which by international law or treaty or convention the United States exercises national jurisdiction. Aircraft of the armed forces of any foreign national shall not be navigated in the airspace of the United States, including the Canal Zone, except in accordance with authorization granted by the Secretary of State.[70]

Of course, the Canal Zone no longer being in the possession of the United States, the passage indicates its age. The modern incarnation of the Federal Aviation Act states simply "[t]he United States Government has exclusive sovereignty of airspace of the United States."[71] Regardless of the wording, it is clear that *cujus est solum*, and thus sovereign control of airspace, has remained a governing national concept.

One short note should be made. Sovereignty over the air has become so entrenched that it is essentially a form of customary international law. Its acceptance is no longer doubted.[72] Thus, as a custom, it is protected from any kind of rapid change, and will therefore likely continue to govern airspace despite the complications it might lend to craft traveling through airspace to reach outer space, or hybrid craft capable of utilizing both spaces. Custom is a principle of highest import in the international arena. The United States Supreme Court noted the importance of custom regarding the law of the sea, writing: "Undoubtedly, no single nation can change the law of the sea . . . . Like all the laws of nations, it rests upon the common consent of civilized communities. It is of force, not because it was prescribed by any superior power, but because it has been generally accepted as a rule of conduct . . . ."[73] This principle was upheld even with respect to certain institutions which had been re-

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[70] Federal Aviation Act, 72 Stat. 798 (1958) (current version at 49 U.S.C. § 40103(a)(1) (1994)).

[71] Federal Aviation Act, 49 U.S.C. § 40103(a)(1) (1994).

[72] *See, e.g.*, Cooper, *supra* note 36.

[73] The Scotia, 14 Wall. 170, 187 (1872).

jected by some States, but not by others. The slave trade was one such instance, and the United States Supreme Court, under Chief Justice Marshall, noted "that which has received the assent of all, must be the law of all . . . . [a]s no nation can prescribe a rule for others, none can make a law of nations."[74]

C. Drawing the Line, the Delimitation and Identification of Airspace

One of the most intriguing things about space, in this author's opinion, is that no one seems to know exactly where it begins. By equivalence, no one seems to know where the air ends. The delimitation of where Earth ends and space begins was of monumental import to early space lawyers. John Cobb Cooper noted that "[u]nless we know the boundary between territorial airspace and international outer space grave practical control questions will necessarily result."[75] Furthermore, "The lower the upper limit of the territorial airspace, the greater freedom will exist in planning such launchings and reentry."[76] Thus, the delimitation of space seemed important in light of how sovereignty should extend beyond national land, sea, and airspace. Indeed, the concern for extension of sovereignty into space was shared by the drafters of the Outer Space Treaty, which was made apparent with the language of Article II.

Before the Outer Space Treaty was even written, scholars were debating how, and to what extent, sovereignty should extend into space. S.M. Beresford suggested that the reason for sovereignty in space would include the prototypical factors underlying all sovereignty—the ability to control a Nation-State's security and effective control over territory.[77] Indeed, "[i]n extending national sovereignty away from the center of the earth, therefore, the minimum distance is set by the requirements of

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74 The Antelope, 10 Wheat. 66, 121-22 (1825).

75 Letter from John Cobb Cooper, President, International Institute of Space Law, to L. R. Shepherd (Jan. 30, 1962) (available through the Andrew G. Haley Archive, *available at* http://www.spacelaw.olemiss.edu/archive/haleyarchive.htm).

76 *Id.*

77 S. M. Beresford, *The Future of National Sovereignty*, *in* PROCEEDINGS, SECOND COLLOQUIUM ON THE LAW OF OUTER SPACE, at 5 (IISL, 1959).

safety and defense, and the maximum distance is the limit of effective control."[78] The idea of protecting sovereignty during this time was made all the more urgent by the Cold War and the pressures felt by the two great powers—the U.S.A. and the U.S.S.R. The two countries needed to find a way to prevent destruction and world catastrophe without the cessation of their respective outer space agendas. Both countries needed to continue in space, both to assure one another of military strength, and to win the tides of world opinion. William Hyman noted the seriousness of the times, but added there were ways to prevent destruction:

> The increasing use of air space and outer space is the avenue to either peace or war. The hazards of such use can be overcome by the cooperation of scientists, lawyers and diplomats. Scientists must inform the public of all scientific advances. Lawyers must devote themselves to the drafting of laws, obedience to which will be compelled by informed public opinion. Politicians must cooperate and forswear arbitrary action.[79]

The drafting of laws of which Hyman spoke referred to the delimitation problem. Only when air and space could be separated could peace truly thrive. Henri T. P. Binet believed that "there is only one way to settle the issue: an international agreement!"[80] Since violations of sovereignty are often the most dangerous threat to peace, demarcating the boundaries between air and space could prevent international events from turning into international incidents.[81] This would especially be so if Nation-States preferred sovereignty in space itself as the regime of the future. Binet suggested the Nation-States would prefer to have sovereignty in space rather than "freedom of space," which is antithetical to the actual result that culminated in the Outer Space Treaty (i.e., Nation-States showed that they preferred freedom of space, not sovereignty as the legal scheme under

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[78] *Id.* at 7.

[79] William A. Hyman, *Sovereignty over Space*, *in* PROCEEDINGS, THIRD COLLOQUIUM ON THE LAW OF OUTER SPACE, at 26 (IISL, 1960).

[80] Henri T. P. Binet, *Toward Solving the Space Sovereignty Problem*, *in* PROCEEDINGS, SECOND COLLOQUIUM ON THE LAW OF OUTER SPACE, at 11 (IISL, 1959).

[81] Hyman, *supra* note 79, at 30.

which space operations were to operate), but his prediction lost to the proponents of free use of space. That concept will be explored below in the essay.

Despite the end result of the Outer Space Treaty, attempts were made to determine a line between air and space. The attempts probably stemmed from the idea that air space was sovereign, and since outer space was simply air space at a higher altitude (and without air, the author might add), then sovereignty should exist there too.[82] Even before the Chicago Convention's establishment of sovereignty of a Nation-State's air space,[83] previous agreements held the principle in like esteem. Dr. Samuel Kucherov noted:

> Thus, in international law practice, states exercised full and exclusive sovereignty in airspace before it was generally accepted in the Paris Convention of October 13, 1919. Already before World War I a number of states protested against violation of their sovereignty in the air by belligerents. For example . . . [t]he United States prohibited the overflying of the Panama Canal by belligerents on 13 November 1914.[84]

The question remained as to where the line should be drawn.

The line-drawing is divided into essentially two camps. The first is that of the spatialists, who wish to define a stable, constant line by which to judge the transition from the air regime to the space regime. The second is that of the functionalists, who believe that there should be no solid line defining space; rather, vehicles should be adjudged according to the regime that best suits their function. Thus, if a craft operates only in air,

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[82] *Cf.* Declaration of the First Meeting of Equatorial Countries ("Bogota Declaration") of 3 December 1976, http://www.jaxa.jp/library/space_law/chapter_2/2-2-1-2_e.html (last visited Feb. 17, 2009); *See also* COLOMBIAN CONSTITUTION, ch. 4, art. 101 ("También son parte de Colombia, el subsuelo, el mar territorial, la zona contigua, la plataforma continental, la zona económica exclusiva, el espacio aéreo, el segmento de la órbita geoestacionaria, el espectro electromagnético y el espacio donde actúa, de conformidad con el Derecho Internacional o con las leyes colombianas a falta de normas internacionales."), http://pdba.georgetown.edu/Constitutions/Colombia/col91.html.

[83] Binet, *supra* note 80, at 14.

[84] Samuel Kucherov, *Sovereignty and Sovereign Rights in Outer Space*, *in* PROCEEDINGS, FIFTH COLLOQUIUM ON THE LAW OF OUTER SPACE, at 5 (IISL, 1962).

like a 747, air law should govern. Likewise, if a craft is designed to work in space, like a rocket launching a satellite, space law should govern. The functionalist approach allows for greater flexibility of evolving technology, since any line drawn by the spatialist approach could become burdensome should certain craft be developed that challenge the limits of the line. On the other hand, the functionalist camp faces problems with the possibility that a vehicle could be developed that possesses the ability to fully operate in either air or space.[85]

Bin Cheng has suggested the presence of a third group, amongst which he places the United States, the United Kingdom, and Germany.[86] This third group contains entities that simply are not sure where the line is or should be, and that might say to "the world at large, 'Of course we all know where space is, but there is really no need for you to worry about it, because it is way beyond you.'"[87] The United States opposed the attempt to define where airspace ends and outer space begins, since such attempts would lead to an arbitrary boundary that was scientifically unsound and that could cause problems in the future.[88] Others, such as the Czech Republic and Denmark, believe in the importance of establishing both a definition of space and the delimitation of outer space, but nevertheless argue that "the current level of space and aviation activities does not seem to require the adoption of a treaty definition and/or delimitation of outer space, and for the present this issue could be left to the theory and practice of States."[89]

Should the spatialist concept be employed, the varied possibilities provide numerous options. It is possible that the line should be placed at the limit of the atmosphere (wherever that is).[90] A second possibility is that the atmosphere can be divided

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[85] A possible example from science-fiction are the shuttlecraft from Gene Roddenberry's Star Trek franchise.

[86] Bin Cheng, *The Legal Status of Outer Space and Relevant Issues: Delimitation of Outer Space and Definition of Peaceful Use*, 11 J. SPACE L. 89, 93-94 (1983).

[87] *Id.* at 93.

[88] Stephen Gorove, *How High is High and Other Cosmic Questions*, 12-FEB BRIEF 9, 9 (1983).

[89] U.N. Doc. A/AC.105/889/Add.1, *supra* note 8, at ¶ 8.

[90] U.N. Doc. A/AC.105/C.2/7 (May 7, 1970).

into its parts (e.g., troposphere, stratosphere, etc.) and a line could be derived from that point.[91] It is possible that the limit could be set at the highest location at which aircraft can operate.[92] This possibility reflects the ICAO definition, where airspace is "only that space in which an aircraft can operate."[93] Unfortunately, this definition is not a solid one, since changing technology will change where aircraft can operate.[94] A fourth possibility is if the von Karman Primary Jurisdictional Line (discussed below) is selected—it would place the line at 275,000 ft, where aerodynamic lift gives in to centrifugal force.[95]

A fifth possibility is that the line is where the lowest perigee of a satellite is orbiting.[96] The problem with this is that, again, as technology changes, where this line is would also change. Consider that a line that is proposed today for the lowest perigee could be usurped by a lower perigee from a satellite twenty years from now. Should that happen, the absurd situation could arise where a new satellite finds itself in what is technically the airspace of a sovereign Nation-State that would, at that point, posses the right to destroy the satellite.[97] A sixth possibility is to draw the line where the gravitational pull of the Earth ceases.[98] However, this author would suggest that this would mean that certain gravity controlled objects, like artificial satellites, would then be considered within airspace—an absurd outcome. A seventh possibility is that the line should be drawn

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[91] *Id.* at 36.
[92] *Id.* at 37.
[93] ICAO definition of airspace, *cited in* Stanley B. Rosenfield, *Where Air Space Ends and Outer Space Begins*, 7 J. SPACE L. 137, 139 (1979); *cf.* the definition of aircraft, ICAO Annex 1 Personnel Licensing, p. 1-1 (Jan. 11, 2001).
[94] Rosenfield, *supra* note 93, at 139.
[95] U.N. Doc., *supra* note 90, at 43. Centrifugal force is not actually a real force at all. It may be defined as "[a]n outward pseudo-force, in a reference frame that is rotating with respect to an inertial reference frame, which is equal and opposite to the centripetal force that must act on a particle stationary in the rotating frame." MCGRAW-HILL DICTIONARY OF PHYSICS 62 (Sybil Parker ed., 2nd ed. 1997). The "force" pushing an object outwards away from the center of a circle is simply that object attempting to proceed via inertia on its tangent at any given moment. However, that fact does not render the von Karman Line immaterial.
[96] *Id.* at 45.
[97] Ricky J. Lee, *Reconciling International Space Law with the Commercial Realities of the Twenty-First Century*, 4 SING. J. INT'L & COMP. L. 194, 209 (2000).
[98] U.N. Doc., *supra* note 90, at 48.

at the highest bounds of where a Nation-State can enforce its sovereignty.[99] "It would mean that the more powerful States, with their high altitude rockets, would be able to control the 'airspace' over their surface territories. The weaker States, however, would be unable to exercise such control."[100] Obviously, this possibility would be unworkable in the international context.

An eighth possibility is that there should be a zonal system, by which there is one zone controlled by sovereignty (presumably airspace), another zone for transitional purposes, and a final zone where the law of space takes over.[101] This last proposal was put forward in 1956 by Professor Cooper of McGill University, who proposed that the middle zone be 300 miles up, and available for traversal for all non-military aircraft (since there would still be sovereignty here).[102] Contrast the 300 mile limit to that proposed by the Nazis in 1939, who argued that a 3 mile limit for jurisdiction should exist that mirrored the 3 mile jurisdictional zone afforded territorial waters.[103] A ninth possibility is to draw the line after a fashion of one or more of the above proposals.[104]

One of the most famous attempts at delimitation was the von Karman Line. Some proposed that the so called Karman Primary Jurisdictional Line (or, von Karman Line) would be the best candidate, since it "is susceptible to determination because of aerodynamic reactions and is here proposed as the line of demarcation between airspace and space."[105] However, there is little to suggest that other lines, both above and below the Karman Line, could not be selected to demarcate the difference be-

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[99] *Id.* at 49.

[100] HALEY, *supra* note 38, at 83.

[101] U.N. Doc., *supra* note 90, at 52.

[102] HALEY, *supra* note 38, at 84.

[103] *See* N.Y. TIMES, Nov. 24, 1939, at 1,16; *accord* Arthur K. Kuhn, *Aerial Flights Above a Three-Mile or Other Vertical Limit by Belligerents Over Neutral Territory*, 34 AM. J. INT'L L. 104, 104-05 (1940).

[104] U.N. Doc., *supra* note 90, at 54.

[105] George D. Schrader, *National Sovereignty in Space*, *in* PROCEEDINGS, FIFTH COLLOQUIUM ON THE LAW OF OUTER SPACE (IISL, 1962); *see also* Jerzy Sztucki, *On the So-Called Upper Limit of National Sovereignty*, *in* PROCEEDINGS, FIFTH COLLOQUIUM ON THE LAW OF OUTER SPACE (IISL, 1962).

tween air and space. If the answer were simple, the ideas of whether and how to extend sovereignty into space would have been resolved long ago. At present, this author knows of no universally agreed upon demarcation line, and that is just as well, since the sovereignty issue may have no readily discernable conclusion.

Despite the above sentiment, serious efforts have been made on behalf of the von Karman Line. Andrew Haley was a major proponent of the idea, devoting substantial efforts to defending it in his writings.[106] The von Karman Line was set at approximately 275,000 feet, with emphasis on its approximate nature.[107] It was believed that the Line would be worked out more precisely with further scientific efforts, and that in any case the Line represents a median measurement akin to a mean sea level (albeit a more complex concept than that).[108] Haley believed the von Karman Line is unique to the law, since many scientists probably thought that the delimitation of space was irrelevant, especially for their purposes.[109] Haley noted:

> Ironically enough, the lawyer finds the main crackpots and nuisances among engineers and sociologists who assume the role of amateur lawyers and give vent to their rather silly if harmless rhapsodies in a field wholly unfamiliar to them. To them the very real task of delimiting airspace is wholly unnecessary. The sound scientist, on the other hand, avoids legal interpretation while at the same time making an essential contribution by staying within his technical expertise and keeping the lawyer well advised on appropriate physical phenomena. Such was the most helpful role of Dr. Theodore von Karman.[110]

Despite the high praise, the von Karman Line has not to date been accepted as the most viable option for delimiting airspace. Like many other proposals, it is still at least somewhat

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[106] *See generally*, HALEY, *supra* note 38.

[107] *Id.* at 78; *see also*, Letter from E. Sänger, Professor, to Andrew G. Haley, President, International Astronautical Federation (Apr. 9, 1958) (available through the Andrew G. Haley Archive, *available at* http://www.spacelaw.olemiss.edu/archive/haleyarchive.htm).

[108] HALEY, *supra* note 38.

[109] *Id.* at 97.

[110] *Id.*

arbitrary, and, at the very least, faces the problem posed by technology that may one day be able to perform just under or above the line, thereby frustrating the identity of which legal regime applies.

The question thus arises, should delimitation even be sought, and if so, what general principles could be agreed upon in lieu of the proposals heretofore described?

Beresford suggested that the idea of sovereign territory in space would be astronomically impossible in the first place.[111] This is especially important, since if as some proposals have suggested[112] (that the extent of sovereignty reaches far into what is colloquially thought as space), planetary physical realities cause problems. Beresford's analysis astutely pointed out the futility of sovereignty in space when he wrote that:

> Let us first consider the view that national sovereignty extends into outer space without any limit whatever. A cone of sovereignty conceived as stretching into space from the center of the earth through the territorial boundaries of each nation would clash with the facts of astronomy. With the movement of the earth and other astronomical bodies, the concept of each nation's cone of sovereignty would change continually. Any given point in space would constantly pass from one cone of sovereignty to another. A rocket could not go from the earth to the moon, for example, without crossing through the sovereign space of many nations.[113]

Thus, the full range of sovereignty may be impossible to determine. Early space lawyers realized that the solution was to form a treaty regime that governed behavior in space—one that might preclude sovereignty altogether. Beresford, for example, predicted that "limited particular agreements . . ." might aid the situation.[114]

Stephen Gorove joined Beresford in decrying the thought of extending sovereignty into space. He believed that such an extension was not workable, and that the real problem was to

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[111] Beresford, *supra* note 77, at 6.
[112] *See* U.N. Doc., *supra* note 90, at 45, 48.
[113] *Id.*
[114] *Id.* at 9.

identify where the airspace ended.[115] Thus, Gorove believed, as have so many others, that the legal concerns of airspace—and the sovereignty carried within—were of the utmost importance.[116]

If sovereignty would not reign supreme in space, some other concept would have to apply. Would the result be freedom in space, or absolute prohibition? The first concept is that of *res communis*, and the latter that of *terra nullius*. It is the former concept that was enshrined by the interpretation of Article II of the Outer Space Treaty. On the other hand, air law is dependent on the concept that air above legally held ground territory is neither *res communis* nor *terra nullius*.

D. *The Future of Sovereignty:* res communis*, the contrast to* Cujus est solum, ejus est usque ad coelum

The words of Article II of the Outer Space Treaty do not express a preference for either *res communis* or *res nullius*. They simply prohibit any nation from establishing sovereignty in space. Thus, the question remained as to how space should be perceived. The options were twofold: 1) space could be open to all for exploration and use; or 2) space could be closed to any nation—at least any nation in particular. If the second option were chosen, it is possible that a created world space agency might license activity in space for any given Nation-State, but such an agency has never been created. The former choice was selected by time and precedent, and it comports with the essence of the Outer Space Treaty's desire to promote peace among humankind in the use and exploration of space.[117]

The origins of *res communis* can be traced back to ancient Roman times, when the concept was referred to as *res communis omnium*.[118] The term referred to those qualities of nature

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[115] HALEY, *supra* note 38, at 94.

[116] *See* John Cobb Cooper, *Report of the Chairman of Working Group I*, International Institute of Space Law (Aug. 15, 1964) (available through the Andrew G. Haley Archive, *available at* http://www.spacelaw.olemiss.edu/archive/haleyarchive.htm).

[117] Outer Space Treaty, *supra* note 6.

[118] Aldo Armando Cocca, *Determination of the Meaning of the Expression "Res Communes Humanitatis"*, *in* PROCEEDINGS, SIXTH COLLOQUIUM ON THE LAW OF OUTER SPACE, at 1 (IISL, 1963).

that belonged to all people, such as air, water, and the oceans.[119] Interestingly, as has been shown here, not all air belongs to everyone according to international precedent. Allowance was made for all so that these things should be taken by no one man to the exclusion of another. These rules are essentially a matter of *ius naturalis*, or the natural law.[120] Natural law has been utilized throughout the millennia as the kind of law that comes most easily to developing peoples. In philosophy, natural law would be an extension of what is called deontological ethics—i.e., what one *ought* to do is what is right. One ought share the great resources of the planet—the commons. One ought not deny to others that which clearly belongs to all. The *res communis* principle captures this spirit. It is very much related to the ideal of equity, where all should be treated fairly. Thus, it is not surprising that this principle has come to dominate the implementation of Article II.

Terra nullius, on the other hand, could be translated as "no country," or "no land." This means that should this definition be employed in space, the vast realm of outer space belongs to no Nation-State. At first, this appears to be equivalent to *res communis*, but in fact that concept is phrased in a positive light, whereas *terra nullius* possesses a negative tone. If *terra nullius* were chosen, one interpretation would be that space and all its resources was an open field—a free for all whose resources could be devoured by the Nation-States first to get there. On the other hand, as has been noted, space could have been subjected to the sovereign control of Nation-States via the principle of *cujus est solum*. However, that option was not selected, and *res communis* allows a much more optimistic spirit of exploration and sharing to prevail. This is the peace-promoting concept, and the one that fits more fully with the preamble to the Outer Space Treaty.[121] In fact, the entire treaty regime is an effort aimed at assuaging the fears and promoting the hopes and dreams of all humankind. As Joanne Irene Gabrynowicz has noted, "[b]orn of Cold War forces, the COPUOS space treaties

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[119] *Id.*
[120] *Id.*
[121] Outer Space Treaty, *supra* note 6.

contain both the aspirations and fears of the times. Their affirmative mandates include that space is 'the province of all mankind' and is not subject to national appropriation by the exercise of sovereignty."[122] This language encompasses the words and essence of Article II. Therefore the logical, and equitable, choice is the extension of a spirit of cooperation into space, and to interpret Article II of the Outer Space Treaty as professing *res communis* over exclusionary theories like *terra nullius*.

Indeed, early space lawyers found that initial satellite launches whose orbits passed over other Nation-States' territories indicated that space may be a *res communis* jurisdiction by matter of customary international law.[123] "The Committee . . . believes that, with this practice, there may have the effect that, in principle, outer space is, on conditions of equality, freely available for exploration and use by all in accordance with existing international law or agreements."[124] The Soviets suggested that spacecraft be granted a right of passage through what would otherwise be the sovereign airspace of a Nation-State.[125] William Hyman proposed a list of provisions that should be adopted by an international convention (presciently predicting the Outer Space Treaty, which came after his commentary):

> c) That all Outer Space be deemed *res communis* (and not *terra nullius*);
>
> d) That the interplanetary system be deemed *res communis* (and not *res nullius*);
>
> e) That recognition be given to the distinction between "*res communis*" and "*terra nullius*" (the former denying rights of appropriation and exclusive control by any one nation, the latter conceding such rights of appropriation through the established principles of discovery, habitation, and settlement) . . .[126]

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[122] Joanne Irene Gabrynowicz, *Space Law Its Cold War Origins and Challenges in the Era of Globalization*, 37 SUFFOLK U. L. REV. 1041, 1043 (2004).
[123] Binet, *supra* note 80, at 12.
[124] *Id.*
[125] Rosenfield, *supra* note 93, at 138.
[126] Beresford, *supra* note 77, at 34.

Early efforts to establish *res communis* as a guiding principle were successful, and since then a spirit of cooperation, for the most part, has prevailed in outer space relations. No one put this more clearly than Carl Christol, who noted that "[d]uring the negotiations and drafting of the agreement, and in subsequent state practice, it has become clear that the space environment is perceived in international law as a *res communis* . . . ."[127] The future of space law depends on submission to the *res communis* principle. So long as it governs, in many respects it controls what can be used and owned in space—an issue particularly germane to Nation-States, companies, and individuals interested in utilizing space and the celestial bodies.

Certitude may be granted by the outer space regime regarding what conception of sovereignty governs in space, but the problem still remains—where does it begin, and air end? Should humanity be unable to solve this conundrum, the possibility that Nation-States may become confused about what law to apply will constantly raise its head. Especially in an era where private space flight is becoming more and more a reality as the years go by, uncertainty as to whether new craft are considered spacecraft or aircraft could quash needed investment in future technologies. Adding to the problem, the question as to how jurisdiction over individuals applies is complicated by the inability to delimitate the line between air and space; indeed, is an actor on a vessel presumed to be an aircraft treated as an astronaut if her vessel crosses one of the suggested lines between air and space, and how will Nation-States' Authority reach such individuals?[128]

Unfortunately, no readily agreed upon definition has been proposed, and therefore the distinction between airspace and outer space, *cujus est solum* and *res communis*, remains murky. This author concurs with Haley, Cooper, Gorove, and many others that it is important to flesh out a line sooner rather than later. The legal problems that seem somewhat theoretical at

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[127] Carl Christol, *Article 2 of the 1967 Principles Treaty Revisited*, 9 ANNALS OF AIR & SPACE LAW 217, (1984).

[128] *Cf.* P.J. Blount, *Jurisdiction in Outer Space: Challenges of Private Individuals in Space*, 33 J. SPACE L. 299, 300 (2007).

this point could become starkly real should a problem occur (e.g. the destruction of a satellite) at a point somewhere in between what is generally regarded as outer space, and what is typically thought of as airspace.

CONCLUSION

History is replete with the machinations of individuals and Nation-States trying to understand where and at what level their power extends. Law is in a very real sense about control as much as it is about order. From Papal times to Westphalia and beyond, the concept of sovereignty has continued to mutate, and sovereign control over airspace has changed focus from the individual in Rome and the common law, to the faceless Nation-State. The realities of the modern world have produced a plentitude of suggested solutions to where this sovereignty should end, and though to date no perfected solution has presented itself, the need for one has only increased with time. Humanity's ability to create such abruptly different regimes—such as Article II from the Outer Space Treaty, and absolute sovereign control under the Paris and Chicago Conventions—suggests that delimitation is possible, though difficult to discern. With time, perhaps history can show humanity a way to truly discover how high the sky goes.

THE OPENNESS PRINCIPLE IN MULTILATERAL AGREEMENTS FOR SPACE EXPLORATION

M. Jude Egan[*] *& James J. Hurtak*[**]

ABSTRACT

The 2006 release of NASA's new Vision for Space Exploration, including the Lunar Architecture program, represents a step forward for the human exploration of Mars. To that end, the NASA Global Exploration Strategy was a significant first step toward developing a model of global participation, but it falls short in terms of the global cooperation and international joint ventures that will likely be necessary given the funding and technological needs required for a decade-long program to put humans on the Martian surface. With US national funding commitments to the space program constrained by domestic and international funding priorities and with the potential for cost overruns over long time-scales and multiple political administrations, any real potential for human exploration of Mars will likely require international cooperation.

The NASA Global Exploration Strategy involved NASA asking the world's thirteen space agencies and a variety of experts about their visions of space exploration, including priorities for research, but did little to form a coherent international agenda. Rather than a go-it-alone approach, a first priority for the NASA

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Vision for Space Exploration program should be the establishment of an international space partnership.

This international space partnership should include a multilateral agreement between the participating states to establish policies for levels and types of participation, information sharing, handling dual use technologies, remote sensing, and the allocation of legal liabilities. This Agreement would have the principle of openness at its core. While a pragmatic multilateral agreement would build upon both the common and civil law traditions, it would be based on a broad vision of contract as a way of establishing clear boundaries and obligations between signatories.

As clear and transparent contracts often make for the best relationships between signatories and, as multilateral agreements may sometimes have a normative, aspirationial character to them, we propose that any such Agreement be guided by a principle of openness. The Openness Principle as we propose it includes: 1) Open Source Resources and Technology Licensing, 2) Open Access and Non-Discrimination Policies Between Nations, and 3) Open and Transparent Agreements.

A multilateral agreement will have to cover potential problem areas concerning the ways and means of getting to Mars, such as technology research and development, cost sharing, potential environmental degradation and protection, and security concerns. We must also consider the possibility of discovering new and valuable Martian resources – requiring clarity between the domestic private property regimes and public resource and environmental stewardship for the planet, which should include developing nations that would otherwise not have the standing to participate.

I. INTRODUCTION: MULTILATERALISM DEFINES THE 21ST CENTURY

As Earth citizens commence the launching of space platforms and lunar bases and become a space-faring civilization in the higher frontier, such exploration will require an international legal framework that embodies the principle of the free and open use of the outer space environment and its planetary bodies. Exploring Mars, the most immediately feasible of

Earth's planetary neighbors and likely the first target of human space exploration beyond the moon, will require multilateral agreements for all levels of the expedition, from the Space Transport Multilateral Agreement we propose here to agreements that set forth environmental policies and property and resource allocation regimes on extraterrestrial bodies once humans land on them.

The way to think about openness and transparency in international agreements is as a way of creating good research relationships. With the Chinese government considering a human settlement on the Moon and strong evidence of the existence of water on or beneath the Martian surface seemingly everyday, we may be heading into what is potentially a new space race. What this new space race has as its underlying concern remains to be seen, but recent saber-ratting suggests that at least a portion of the missions, whether Chinese, American, European or Russian have military and strategic aims. Dual-use technologies, those that can be used for both research and military aims, such as remote sensing technologies, rocket boosters and launch platforms, tracking and positioning technologies, etc., foster uncertainty between nations – one may declare publicly a scientific research agenda while clandestinely building military capability. No player being able to trust any other player, leads to a go-it-alone philosophy that has the potential to damage the major scientific research goals of interplanetary exploration – international cooperation would likely relieve single player budgetary pressures, reduce research replication and amplify scientific knowledge.

At the outset of this new space exploration, with greater technological prowess, new financial incentives in the private sector and increasing economic feasibility of space-based activities, we must build on the United Nations' conventions and international treaty regimes governing local space activities and create a "law of space" that will govern both the relatively local near Earth orbit and more far-reaching space exploration. Increasing activity in the private sector, conjoined with increasing military concern for space-based technologies, encourages an even greater need to create a set of rules that will govern how and for what purposes space may be used.

Conceptualizing a law of space requires two levels of analysis: on the one hand, it entails the creation of a working set of agreements and doctrines regulating the activities of space-faring nations in the areas outside of the planetary airspace by creating enforcement mechanisms and rules for information gathering, liability allocation, property rights and environmental protection. This type of legal regime governs the relatively mundane legal and physical realities of space activities: objects move, information is gathered and transmitted, resources may be discovered, property may be owned, contracts may be entered into and torts may be committed; for this space we must create agreements pertaining to the relationships between planetary support staff for how to govern interactions outside the atmosphere.

On the other hand, at a time when space travel and exploration are becoming a greater reality and as environmental and economic problems plague the Earth and set the human imagination looking outward for new possibilities, conceptualizing a law of space creates an opportunity for futurist thinking – rational problem-solving for challenges that have not yet become reality. The citizens of Earth have an opportunity to use their own historical frames of reference to create a legal regime based on the knowledge they have gained from the practice of the rule of law on Earth. At a crossroads, as near Earth space is becoming a valuable economic resource, Earth citizens must decide whether to allow the private sector to set the regulatory and policy agenda for ever-expanding exploration – the search for resources – or to foster a regulatory agenda that benefits humanity as a whole by providing opportunities for joint exploration, research partnerships and information gathering – the search for knowledge.

Thinking through such a legal regime puts a series of difficult questions to citizens of the Earth given wealth disparities between nations, trade gulfs, multinational corporate agendas, environmental damage, resource depletion, treaty regime enforcement, and liability allocation: who should set the rule-agenda? Who should benefit from exploration and discovery? Who should bear the costs and the risks?[1]

A law of space also gives an opportunity for humans to ask other important political questions as though they were behind the Rawlsian veil of ignorance:[2] what environmental laws would we create if we had a pristine world in and for which to create them? How would we allocate property and resources? How would we ensure that all are protected by distributive justice concerns? How would we develop in a smart and coherent manner that best benefits all while still providing incentives for each?[3]

We take a human mission to Mars as an example of the next steps in space exploration, in part because it is increasingly on the exploration agenda and in part because of the recent strong evidence of flowing water upon and below the surface of the planet.[4] The development of a set of Multilateral Agreements is a necessary first legal step for a manned mission to Mars. Useful Agreements will need to address technology transfer, information sharing, environmental management, and equipment and mission costs.

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[1] These questions are variations of the classic political theory questions: who decides? For whose benefit? At whose expense?

[2] The "veil of ignorance" notion is from Rawls' seminal work of political theory entitled *A Theory of Justice*. The veil of ignorance is a thought experiment whereby Rawls attempts to arrive at the most "just" system of legal rules and resource allocation by imagining what rules we would create if we were in the "original position" with our identities shrouded and we were tasked with creating such a system from scratch. That is, if we did not know our ethnicity, race, religious affiliation, socio-economic status, etc., what rules would we as a society create to best provide for our chances and the chances of others? He settles on the concept of "justice as fairness" as opposed to the Hobbesian savage "state of nature." JOHN RAWLS, A THEORY OF JUSTICE (Belknap Press of Harvard University Press, 1971).

[3] We are, of course, not in an original position, but we are presented with an opportunity to imagine ourselves as explorers and, ultimately, settlers, of new worlds. It is almost even more incumbent upon us to take up John Rawls' original position to help us create the rules that will guide us in deciding how we will govern our conduct both in space and at home. Who goes? For whose benefit? At whose cost? Who shares in the knowledge?

[4] *See* Michael C. Malin & Kenneth S. Edgett, *Evidence for Recent Groundwater Seepage and Surface Runoff on Mars*, 288 SCIENCE 2330-35 (2000); Press Release, NASA, Evidence of Wet Mars Meridiani Planum (Mar. 2, 2004) (Opportunity Rover Finds Strong Evidence Meridiani Planum Was Wet); Press Release, NASA, NASA Images Suggest Water Still Flows in Brief Spurts on Mars (Dec. 6, 2006).

We take the historical frame of reference provided by existing space treaties at the United Nations level as the baseline. As the world community saw the potential significance of space as a strategic military position, it established a series of high-minded agreements that hold space as "the province of all mankind" and establish that space should be used for peaceful purposes only and that the exploration and use of space would be free to all States.[5] The Outer Space Treaty showed the world community at its very best, agreeing to be bound by rules that would foster peace between nations. To that end, we envision a space policy that utilizes the previously established UN space law benchmarks that have created a global ethic of open and peaceful exploration for space activities and greater cooperation between nation-states. This ethic requires that space resources, research, and, in some instances, equipment be shared in a non-discriminatory manner that does not require *quid pro quo* concessions by nation-states that have an interest in but not the funding for space exploration.

The 2006 release of NASA's new Vision for Space Exploration, including the Lunar Architecture program and the NASA Global Exploration Strategy, represents a step forward for the human exploration of Mars.[6] The NASA Global Exploration Strategy is a significant first step toward developing a model of global participation, but it falls short in terms of the global co-operation and international joint ventures that will likely be necessary given the funding and technological needs required for a decades-long program to put humans on the Martian surface. The NASA Global Exploration Strategy involved NASA asking the world's thirteen space agencies and a variety of experts about their visions of space exploration, including priorities for research, but did little to form a coherent international agenda. Rather than a go-it-alone approach, a first priority for the NASA Vision for Space Exploration program should be the establishment of an international space partnership. With US

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

[6] Press Release, NASA, No. 05-361 (Dec. 2006).

national funding commitments to the space program constrained by domestic and international funding priorities and with the potential for cost overruns over long time-scales and multiple political administrations, any real potential for human exploration of Mars will likely require international cooperation.

This international space partnership should include a multilateral agreement between the participating states to establish policies for levels and types of participation, information sharing, handling dual use technologies, remote sensing, and the allocation of legal liabilities. While a pragmatic multilateral agreement would build upon both the common and civil law traditions, it should also be based on a broad vision of contract as a way of establishing clear boundaries and obligations between signatories.[7]

As clear and transparent contracts typically create the least friction between signatories and, as multilateral agreements may sometimes have a normative, almost "aspirational"[8] character to them, we propose that any such Agreement be guided by what we refer to as "the Openness Principle" at its core. The Openness Principle as we propose it includes: 1) Open Source Resources and Technology Licensing, 2) Open Access and Non-Discrimination Policies Between Nations, and 3) Open and Transparent Agreements.

A Multilateral Agreement regarding joint exploration of space will have to cover potential problem areas concerning the

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[7] Basing a multilateral agreement on contractual relations will allow signatories to regulate one another rather than relying purely on state apparatus to do so. International legal regimes have been roundly criticized for having weak enforcement mechanisms and few courts that are willing and able to effectively assume jurisdiction over disputes. Provisions for arbitration and other alternative dispute resolution procedures can create an environment of stability amongst signatories who would otherwise be unwilling to submit themselves to another sovereign's jurisdiction. *See, e.g.*, Louis Henkin, *Politics of Law-Making*, *in* INTERNATIONAL LAW: CLASSIC AND CONTEMPORARY READINGS 17, 18-20 (Charlotte Ku & Paul F. Diehl eds., 1998) (noting lack of enforcement in international human rights law); *see also* Laura A. Dickinson, *Public Law Values in a Privatized World*, 31 YALE JOURNAL OF INTERNATIONAL LAW 383, 385 (2006); *see generally* Tseming Yang, *International Treaty Enforcement as a Public Good: Institutional Deterrent Sanctions in International Environmental Agreements*, BEPRESS LEGAL SERIES 1136 (2006), *available* at http://law.bepress.com/cgi/viewcontent.cgi?article=5381&context=expresso.

[8] *See generally* the discussions regarding multilateral trade agreements and human rights.

ways and means of getting to Mars, such as technology research and development, cost sharing, potential environmental degradation and protection, and security concerns. We must also consider the possibility of discovering new and valuable Martian resources – requiring clarity between the domestic private property regimes and public resource and environmental stewardship for the planet, which in the spirit of the Outer Space Treaty should include developing nations that would otherwise not have the standing to participate.[9]

Thus far no State has been willing to commit the resources necessary to send a human mission to explore Mars alone. This has forced those States that would like to explore Mars to think creatively about which States to invite to participate in order to get funding and technologies needed to make the mission a success.[10] National security and corporate economic concerns regarding "dual use technologies" increase the difficulty of getting nations or corporations to buy-in.[11]

A fully developed principled structure for law of space would provide legitimacy and credibility for concepts ranging from international cooperation to security, but it would also begin to provide structure and incentives within which multilat-

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[9] *See* Outer Space Treaty, *supra* note 5, at arts. I, II, IX, X, XI, & XII. The Outer Space Treaty generally spells out something more than merely non-exclusive use, it contains a spirit of cooperation, sharing of knowledge, and equality of access, even to those States that do not have the resources to go it alone.

[10] Thus, the NASA Global Exploration Strategy is a first step in coalescing international support for a joint exploratory mission or series of missions to Mars. *See* Press Release, NASA, 06-361 (Dec. 4, 2006), *available at* http://www.nasa.gov/home/hqnews/2006/dec/HQ_06361_ESMD_Lunar_Architecture.html.

[11] "Dual-use technologies" refers to the technologies necessary for space exploration that also have potential military uses such as remote sensing equipment, guidance systems and rocketry. For a partial list of technologies the United States military views as dual use or "militarily critical," *see* the Militarily Critical Technologies List, *available at* http://www.dtic.mil/mctl. A second type of "dual use" technology could involve proprietary technologies produced by private firms or state-run space monopolies that are shared as part of the mission's common cause and but that raise intellectual property concerns for their makers. These national security and intellectual property concerns underscore the need for a developed body of law that will equitably allocate liabilities and rewards for space exploration and encourage participation. These are being developed through NASA's "Innovative Partnerships Program" involving university and private partnerships to develop technologies that are economically viable and useful both on Earth and in space. *See* Frank Schowengerdt, *Space Exploration: The Role of the Innovative Partnerships Program*, 12 TECHNOLOGY INNOVATION No.1 (2005).

eral agreements could set forth policies for the treatment of space by humans. It would also recognize the increasingly important issue that near-space is becoming crowded with debris and satellites[12] and that outer space, especially within our solar system, is becoming an increasingly likely destination for humans and spacecraft. Thus, the space regime could have both a private law element and enforcement mechanism on Earth, especially in contract and tort, and an international "federalist" spirit that coheres in a central body of space law.

Such a legal regime that encourages exploration and research sharing would be ahead of the curve, as space utilization is increasing with many new Nation-States and many private entities and even private individuals joining the space-faring order. New applications for orbiting satellites are only the first steps in developing greater scientific, economic, and potentially military uses for near space and many private firms are establishing a near-Earth presence with satellite communications and monitoring systems. Without an agreed upon law of space at the outset that ensures that space will continue to be jointly held, the exploration of which may remain in the aspirations of peoples all across the Earth, we could be face a "tragedy of the commons" situation in which resources, real estate (whether actual land or orbital paths), and waste disposal could be based on the strongest and wealthiest on earth exerting their authority in space, and thus perpetuating the rich-stay-rich fears of

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[12] U.N. Peaceful Uses of Outer Space [COPUOS], Sub-Comm. Scientific and Technical, Technical Report on Space Debris (1999), *available at* http://www.unoosa.org/pdf/reports/ac105/AC105_720E.pdf. Note also that the Chinese anti-satellite missile test in 2007 produced more than two thousand fragments of "trackable" space debris and over one million smaller than a millimeter in size. *See* The Center for Space Standards & Innovation, *Chinese ASAT Test*, *available at* http://www.centerforspace.com/asat/. A Russian satellite broke apart in orbit over Australia in 2007 creating an additional several thousand pieces of debris. *See* Ker Than, *Rocket Explodes Over Australia, Showers Space with Debris*, SPACE.COM (Feb. 21, 2007), *available at* http://www.space.com/news/070221_rocket_explodes.html. A space law regime would account for both types of events, intentional and accidental, if space is to be preserved for safe scientific practices. *See also*, Brian Berger, *NASA's Terra Satellite Moved to Avoid Chinese ASAT Debris,* SPACE.COM July 6, 2007, http://www.space.com/news/070706_sn_China_terra.html (where NASA moved a U.S. satellite out of the orbital path of debris created by the Chinese test.).

nations that would otherwise like to take part in space activities.

Numerous existing bilateral agreements have established procedures and guidelines for transferring potential "dual use" technologies and sharing space platforms, underscoring the increasing legalization of space activities under contract law. But contract is private law between two or more parties, and without both an enforcement mechanism on Earth and without a voice that speaks for the space environment – including its resources, its pristine biological and chemical "environment," and the scientific discoveries that loom there – the agenda will be dominated by those with Earthly power.

As space exploration and research continues on an upward trend, safe and secure technology sharing and transfer, including the protection of intellectual property and patents, is growing increasingly important. Joint ventures into space, whether as partnerships between Nation-States or corporations, require strong treaties or agreements between participants and often are the product of concessions given by all parties at the negotiating table to reach a workable agreement. Multilateral agreements and the joint ventures they support further encourage technology sharing, forcing reciprocal recognition of the rights and laws of additional Nation-States.

However, bilateral or mutual recognition constructs cannot be "multilateralized" automatically, because, based on assessing the current equivalence of regulations, concessions are not interchangeable. Even bilateral agreement protocols must take into consideration national public and private law, including agreements that are carried out by private entities for commercial purposes, often reducing the number of enforceable conditions in agreements. Under multilateral agreements, the mutual recognition of rights and restrictions is more difficult than under bilateral agreements because of the greater incompatibility of laws, regulations and enforcement regimes creating a pressure for even fewer conditions to be considered. Multilateral agreements have a great many benefits in practice, one of which includes customized rights of access obtained through an expanded sense of recognition. In going to Mars, governments negotiating multilateral arrangements should carefully balance a detailed equivalence of practices with a broad balance of concessions.[13]

At a minimum, a preliminary multilateral space law agreement should be based on three broad applications:

1) Nondiscrimination in sharing space resources – including scientific discoveries; natural resources; new information, including biological history, archaeology, and other forms of knowledge we learn about cosmology;

2) Indivisibility of the agreement (collective arrangement); and

3) Diffuse reciprocity in honoring one another's legal rights, liability allocation, and remedies/enforcement procedures between the space exploring nations.

Our focus is the third of these concerns. The problems of multilateral legal reciprocity make forging agreements difficult: in coordinating an agreement with multiple countries as diverse in their laws as the USA, Japan, and Russia for example, whose strategies should be pursued to further space exploration? How much of a role should government space agencies have in a joint venture? How will the parties apportion liabilities and rewards for the mission and who can or will enforce them? One solution is to choose, wherever possible, policies that encourage open idea-sharing with minimal government intervention and place well-defined limits on the types of "dual-use" technologies and intellectual property governments and corporations want to protect, while clearly apportioning liability and describing enforcement mechanisms.

Contract law provides an ideal model for this type of agreement because signatories spell out conditions and rewards at the outset and agree to bind themselves to the terms of the agreement. Because contract is private law, it avoids many of the pitfalls of harmonizing otherwise dissonant public laws and legal regimes that differ from state to state. Since strong centralized enforcement mechanisms are still lacking in international private law, effective multilateral agreements will have

[13] Lisa L. Martin, *Interests, Power, and Multilateralism*, 46:4 INT'L ORG. 765-92 (1992).

the Openness Principle at their core. Openness and transparency in contract design reduces the likelihood of later breach or conflicts over interpretation, thus obviating the need for centralized enforcement mechanisms. Rather than try to create a new and binding enforcement regime, though one should also be in the works, we propose devising contracts to be transparent from the outset.

To be effective, multilateral agreements must provide adequate benefits and protections to all participants that can be exchanged for the costs of sharing technologies and rewards.[14] Thus, pragmatic multilateral agreements that apply to space travel and exploration should include The Openness Principle, an approach that will foster cooperation, collaboration and transparency in ventures into space and will be based on the United Nations Treaty regimes that are currently in place.

A. The Openness Principle as Applied to Multilateral Agreements for Space Exploration

The Openness Principle as we propose it includes: 1) Open Source Resources and Technology Licensing, 2) Open Access and Non-Discrimination Policies Between Nations, and 3) Open and Transparent Agreements.

In the common law tradition, every contract has an implied covenant of good faith and fair dealing, which holds that parties to a contract are to keep their word and not try to escape their obligations in the contract.[15] To that end, the Openness Principle has a normative dimension to it. Openness suggests at the outset that the signatories to any such contract agree that they do not intend to later breach or call well understood, negotiated terms into question. Openness also serves to reduce worries that other signatories are silently breaching the Agreement.

The ideal long-term contract should anticipate and address potential challenges from the beginning and then set forth a

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[14] Kaylpso Nicolaidis, *International Trade in Information-based Services: The Uruguay Round and Beyond*, *in* WILLIAM DRAKE, THE NEW INFORMATION INFRASTRUCTURE 297-98 (Twentieth Century Fund Press, 1995).

[15] *See* RESTATEMENT (SECOND) OF CONTRACTS § 205 (1981).

principled way of responding to inevitable scenarios that are not contemplated when the parties negotiate initially.[16] An ideal multilateral agreement also sets forth individual parties' liabilities and obligations, along with how to handle intellectual property, dual-use technologies, security concerns and military build-out.

The three elements at the core of the Openness Principle also carry with them the aspirational character of space exploration itself, presuming that the principles behind existing United Nations' treaties, such as "the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes,"[17] space being "the common heritage of mankind,"[18] and environmental treaties that provide for equitable access to resources and knowledge will be the continued goal of any joint mission to Mars. As a result, the Openness Principle, as we define it, leans toward a reduction in private corporate agenda setting and an increase in the role of a centralized private law system of creating and enforcing obligations between Nation-States.[19] Our goal in this paper is to outline a

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[16] Thus, a good multilateral agreement would include dispute resolution processes as well as anticipating unknowns such as research applications, resource allocation, etc.

[17] Outer Space Treaty, *supra* note 5, at Preamble.

[18] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, opened for signature Dec. 18, 1979, 1363 U.N.T.S. 21 [hereinafter Moon Agreement]. *See also* Daniel C. Turack, *Concept of the Common Heritage of Mankind in International Law*, J. OF THIRD WORLD STUDIES (Fall 2002); KERNEL BASLAR, THE CONCEPT OF THE COMMON HERITAGE OF MANKIND IN INTERNATIONAL LAW (Martinus Nijhoff Publishers, 1998). The latter studies compare the concepts of the Common Heritage of Mankind in the law of the sea, outer space law, environmental law, human rights, humanitarian law, and its place as a general principle of law as it pertains, for example, to territory and sovereignty.

[19] In an era in which "efficiency," "privatization," and "globalization" are the dominant forces in the world economy, the goal of reducing private corporate agenda setting should give some pause. This statement is not meant as a polemic against international trade regimes or even reducing the power of the private sector. What is meant is that the private sector, focused on markets, has little incentive to take the aspirational approach to space exploration. The corporate agenda – to maximize profits for shareholders – has little room for basic scientific research and information sharing. Further, the express goals of the Space Treaties were to provide access to space information, if not space itself, for nations with less access to capital for exploration. The purpose of developing a strong centralized system for private contract enforcement is to encourage participants to continue to do scientific research in space and to share data and information with the developing world.

set of principles that can be applied broadly in multilateral space exploration ventures that will encourage participants to be good citizens, both on Earth and in the cosmos.

i. Open Source Resources and Technology Licensing

Open source resources and technology licensing is a key step in the creating of a vital and vibrant system of space exploration. Our conception is derived from open source software systems. Open source is a software development method that utilizes distributed peer review and transparent processes. The promise of open source "is better quality, higher reliability, more flexibility, lower cost, and an end to predatory vendor lock-in."[20] The open source development and decision-making model is used primarily for software development, but this process itself comes from the scientific method. The notion is that information, to be valuable, must be freely shared so that it may be subjected to falsification and peer review. This model is taking hold in open source decision-making, which allows for a number of different agendas, approaches, and priorities to be inputted concurrently.[21] This provides a contrast to command and control systems where the single agenda (such as profit maximization) dominates all development and operations' processes. Thus, in open source culture, the agenda is jointly created and jointly followed. It relies heavily on transparency and sharing of intellectual property, whether through licensing or through other means of information sharing, so that people may work concurrently in developing the target. The collective approach also provides for a second layer of "checks" at the process level, which moderates ethical concerns regarding conflicts of interest or failures to meet contractual obligations. Open source has become a critical strategic component for the development of new technologies and it has played the decisive role in the creation of scientific knowledge.

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[20] Open Source Initiative, *available at* www.opensource.org.

[21] ERIC S. RAYMOND, THE CATHEDRAL AND THE BAZAAR (3d. ed., 2000) (quoting Linus' law, "given enough eyeballs, all *bugs* are shallow").

Co-participants in international space exploration ventures would be necessarily sharing information and technologies. The synergies that come from sharing and cooperation are a particular strength of joint missions and bring together each of the participants' specialties and produce an amplifying effect on the resources available to the mission. Recognizing that information and technology sharing may produce anxiety in both national security and corporate contexts – the former being concern about the possibility of sharing sensitive information with potential Earth adversaries and the latter with corporate competitors, the latter facing the further challenges of the blurred lines between national space programs and private concerns that are increasingly competing for market share – it is important that sharing of dual-use technologies and intellectual property be accompanied by transparency which acts as a control.

Since a critical feature of joint exploration mission success is a move from competition to cooperation amongst participants, the open source model of information exchange would require that participants share or license information and technology to other participants for the mission or mission-related activities only.[22] Concerns about dual use technologies and intellectual property could be at least partially remedied through licensing agreements and transparent markets for such technologies and information, with partners agreeing to share whatever synergies emerge from bringing such technologies and information together.[23] Participants would license their technologies for the opportunity to participate in whatever rewards were garnered during the mission. Thus, they would be able to "charge" only a nominal fee (or none at all) for the use of the licensed technology

[22] Recall that the model for joint missions into space is a scientific model where openness of and access to scholarship, research and data is a key element of increasing scientific knowledge. A limitation on this type of partnership is the dual nature of missions in general, in which there are both scientific and resource acquisition agendas.

[23] *See*, *e.g.,* University licensing agreements; especially those where there is partnership with industry, i.e. the newly created British Petroleum – University of California, Berkeley partnership for biofuels research. Loosely, the partnership allows basic scientific research to be "kept" and published by UC Berkeley researchers while economically viable research is to be "kept" by British Petroleum. This arrangement is new as of 2007 and the ability of a public university to successfully partner with a private firm remains to be seen.

during the joint venture into space, but would reap the benefits of uses developed while on space missions.

While licensing could solve a portion of the intellectual property issue, it probably would not resolve dual-use technology concerns. The dual-use technology issue is a major one especially as military strategists eye space as a resource. However, there are institutions that monitor dual-use technologies such as chemical weapons[24] and nuclear weapons – such as the International Atomic Energy Agency – for nuclear reactors that suggest dual-use technology will not be a deal-breaker. Biological weapons are proving more difficult for which to create a monitoring and enforcement regime.[25] Openness is one common theme among all of the dual-use monitoring regimes; under the chemical and nuclear weapons treaties, each of the signatories provides access to the technologies, with agreements that limit access to proprietary technologies.

A possible enforcement mechanism would require that ongoing participation be conditioned on honoring open source agreements with participants monitoring themselves.[26] Still another way of enforcing licensing and open source agreements is to offer participants opportunities to use resources available in space in exchange for their participation in a cooperative information and technology-sharing regime.[27] The goal is at once

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[24] The Organisation for the Prevention of Chemical Weapons was created by the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction. *See* Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction, Jan 13, 1993, 32 I.L.M. 800 (entered into force on Apr. 29, 1997).

[25] *See* Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Apr. 10, 1972, 26 U.S.T. 583, 1015 U.N.T.S. 164. It does not provide for monitoring or enforcement, however, and though there has been much interest in creating an enforcement and monitoring regime, the most recent attempts were undermined by the Bush Administration's worry that it would interfere with legitimate commercial biotechnology research.

[26] *See* Richard Schwartz, *Social Factors in the Development of Legal Control: A Case Study of Two Israeli Settlements*, 63 YALE L.J. 471-91 (1954), for the argument that in small societies the need for developed legal rules is much less pronounced than in larger societies because smaller societies are more able to monitor and enforce social norms.

[27] Anthony Rutkowski, *Multilateral Cooperation in Telecommunications: Implications of the Great Transformation*, *in* WILLIAM DRAKE, THE NEW INFORMATION INFRASTRUCTURE 223-250 (1995).

to encourage participation and research (private law) and to create a law of space that provides environmental protection and assures access to information (public law).

There is precedent for sharing ownership and/or control of technologies as when the European-built Cupola observation module for the *International Space Station* (*ISS*) was officially transferred to NASA on 7 July 2005. Under this agreement the European Space Agency provided the Cupola in exchange for NASA's transportation of ESA's equipment and experiments to the Space Station. Cupola's development came as a process of cooperation between six European companies, from Spain, Switzerland, Sweden, Germany, and Belgium and ESA's prime contractor Alenia Spazio. The transfer concluded ESA's obligations for the Cupola's development as part of a bilateral barter agreement between ESA and NASA six years later.[28]

ii. Open Access and Non-Discrimination Policies Among Nations

When agreements are bilateral or small multilateral conventions, partners can be selective about who is allowed to participate and under what circumstances. The Openness Principle requires that new policies for cooperative space ventures require open access and non-discrimination, allowing nations who meet certain criteria to participate automatically in space exploration joint ventures as the equivalent of equity partners. For nations that do not meet the set of criteria, we propose either a benchmarking system with well-defined participation goals and/or a rotating participation system that will allow all nations who wish to participate in the space exploration program to do so.[29]

This will further amplify the understanding reached in the 1967 Outer Space Treaty that:

> The exploration and use of outer space . . . shall be carried out for the benefit and in the interests of all countries, irrespective

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[28] *See ESA Transfer Ownership Of European-Built ISS Observation Module To NASA*, PHYSORG.COM (Jul.27, 2005), *available at* http://www.physorg.com/news5452.html.

[29] This could be based in part on the UN Security Council model.

> of their degree of economic or scientific development, and shall be the province of all mankind.
>
> Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.
>
> There shall be freedom of scientific investigation in outer space, including the moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation.[30]

There is precedent for the development of large technical systems with large infrastructure costs being leapfrogged by more advanced technologies with lower costs via open network access. For example, for over a century, telecommunications networks were managed by select national monopolies that carefully designed complex systems of rules intended to control markets. As telecommunications went to microwave and satellite systems, multilateral sharing of satellite space changed the selection process allowing new countries to participate via the production of viable launch and satellite systems. It also allowed nations for which the build-out of reliable land-based transmission systems was not considered cost-effective by large telecommunications companies to completely bypass that step and go straight to satellite based telecommunications systems. Thus, nations, such as India, Brazil, and Norway, which had been left out of the industry by powerful national monopolies, were given an opportunity to compete.[31]

Good agreement design would encourage future-thinking nations and corporations to participate in joint exploration missions by creating systems to set out participation in terms of benchmarks toward meeting the criteria for participation in the program

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[30] Outer Space Treaty, *supra* note 5, at art. I.

[31] Matthew Jude Egan, *Anticipating Future Vulnerabilities: Increasingly Critical Infrastructure-like Systems*, 15:1 J. OF CONTINGENCIES & CRISIS MANAGEMENT 4-17 (2007).

iii. Open Agreements: Creating Transparency through Multilateral Agreements

The purpose of a new Multilateral Mars Agreement would be to affirm the common needs of developing countries to use orbital and ground data to both better build out their own critical infrastructure and to make use of global, intellectual, and technological resources needed for the first manned mission to Mars. Again, there is precedent for sharing space data as the United Nations Office for Outer Space Affairs (UNOOSA) has sponsored several programs aimed at using remote sensing data to aid the developing world, especially African nations, with sustainability, water resources, and environmental health.[32]

As involving more entities reduces the likelihood of covert cartel-type arrangements,[33] having a dozen space-faring nations with rotating leadership depending on particular strengths and rotating participation for States that do not meet their benchmarks, would work toward ultimately making information and technology available to all. Only a handful of countries have so far demonstrated outer-space competence, but the list is growing, and with benchmarking so States can qualify or rotating limited participation for States that do not qualify, the list will expand further.

A basic list of such Established Space Competent States (EtSC) inevitably includes the USA, the European Space Agency (ESA) as an organization in its own right as well as most of its individual Member States, the Russian Federation, Canada, and Japan.[34] Yet other States such as Australia and China are moving into the commercial space arena.[35] Other nations either

[32] *See* the UNOOSA Programs on Space Technology and Disaster Management and Natural Resources and Environmental Monitoring.

[33] The balance required in the outer space technology context is between having a large enough number of actors to reduce the likelihood of agenda-setting and price-fixing on the one hand and few enough members that the appropriate benchmarks and standards can be assured.

[34] *See* Gasparini Alves, The Transfer of Dual-Use Outer Space Technologies: Confrontation or Co-operation? (2001) (dissertation thesis for the University of Geneva, Institut Universitaire De Hautes Éstudes Internationales), *available at* http://www.unige.ch/cyberdocuments/theses2001/GaspariniP/these.html.

[35] *Id.*; *see also* Gerald Steinberg, *Satellite Capabilities of Emerging Space-Competent States*, *available at* http://faculty.biu.ac.il/~steing/military/sat.htm.

are developing or have developed qualified outer space technologies, some with the aim of joining the ranks of EtSC States and becoming suppliers of technologies and services within the next two decades such as Argentina, Brazil, India, Israel, and Pakistan.[36] To a lesser extent, other States having the capacity to manufacture systems or sub-systems for crucial space technologies, such as South Africa, Indonesia, and South Korea, all have announced their intention to initiate outer space activity sometime in the future.[37]

II. ISSUES FOR PRELIMINARY AGREEMENTS FOR OUTER SPACE

Ultimately, joint space exploration, including a human mission to Mars, would require many agreements and memoranda of understanding (MOUs) of different types including among others: describing detailed space activities and the creation of international institutions involved in this process; the exploitation of space resources; the legal status of spacecraft including international registration; liability for damage to the objects and payloads caused by space activities; assistance to astronauts and spacecraft in distress; licensing requirements for launch activities (as well as launch services); space insurance and liability apportionment; licensing requirements for telecommunications; intellectual property rights under domestic laws; national export controls on space products; financing of space ventures; law and contracts related to materials procurement, leasing of equipment; as well as contractual relationship between space agencies and space industry. There would also have to be agreements regarding dual-use technologies, militarily sensitive technologies and private intellectual property rights.

Bilaterally, as well as multilaterally, there would also need to be agreements established amongst suppliers and recipients, to enable mutual scientific objectives to be complemented by compliance and enforcement procedures, especially important for scientific technology such as remote sensing radar that

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[36] *See supra* note 34.
[37] *Id.*

would be used for ground and orbital surveying of Mars. If these agreements embrace the Openness Principle discussed above, they will allow for limited sharing and licensing but would provide protections for intellectual property concerns.

A draft multilateral agreement would compile aviation, *Space Shuttle* and space station agreements, conventions, and MOUs. The usefulness of a draft agreement compiled from existing agreements is twofold: first, it would show how existing agreements can be reworked to create a workable agreement for joint ventures and second, it would provide a text that can be modified or added to create a working document.[38]

One of the first similar space agreements was the Intergovernmental Agreement (IGA) of 1988 on Cooperation in the Detailed Design, Development, Operation, and Utilization of the Permanently Manned Civil Space Station which provided the mechanism for multi-national use of a space station.[39] In 1993, the original participants to the agreement, the United States and Japan, and to an extent Canada, and certain member states of the European Space Agency (Belgium, Denmark, France, Germany, Italy, Netherlands, Norway, Spain, and the United Kingdom), took an historic step toward advancing the peaceful exploration of space by inviting the Government of the Russian Federation to join the International Space Station Program.[40] In reaching this decision, the partners recognized that including Russia would represent important progress toward their shared objective of establishing broad cooperative relationships in building the International Space Station Program.[41]

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[38] We have proposed draft agreement language to be published. *See* J.J. Hurtak & M. Jude Egan, *Draft Multilateral Agreement for a Manned Mission to Mars* (forthcoming 2009) (on file with author).

[39] 1988 Agreement Among the Government of Canada, Governments of the Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States of America Concerning Cooperation on the Civil International Space Station [hereinafter IGA], http://www.jaxa.jp/library/space.law/chapter_3/3-2-2-9/index_e.html.

[40] The Signatories to the IGA extended an invitation to the Russian Government to join the Agreement on December 6, 1993 and the Russian Government accepted on December 17, 1993. *See id.* at Preamble.

[41] Including Russia and potentially China would be important strategically as well as scientifically. With both nations raising concerns about the US' attempts to "strategically dominate" space with space-based weapons, a "silent" arms race could begin to

The United States had decided that because of its lead role, the 1988 IGA would need to be based on a series of bilateral agreements. Through the initial negotiations, the US followed this line. Halfway into the original IGA negotiations, in the summer of 1987, the US agreed with other participating States that the agreement should be a multilateral "Executive Agreement" because it would expedite the acceptance process.[42] However, the "executive agreement" route also meant that the US negotiators were not in a position to agree with language that would require changes to US laws. Since multilateral agreements do not require Senate approval, they do not have the same status as international treaties and are only enforceable in the US to the extent that they comply with US domestic law; this issue will likely remain an important consideration as participating countries attempt to negotiate new multilateral agreements.

The United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) is the primary international forum for space laws and treaties, especially in the field of joint management or control of objects in space. One of the early treaties it developed was the Outer Space Treaty (1967), a document that could provide a model in terms of international agreements that allow State signatories to retain jurisdiction over aspects of their projects, but given the increasing multilateralization of space missions, the model will need to include provisions for sharing resources as well. According to Article VIII of the Outer Space Treaty:

> 1. A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction

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reemerge. Russia has stated publicly, in cooling ties with Washington DC, that it would place "retaliatory weapons" in space. *See* Vladamir Isachenkov, *Russia Warns against Space Weapons*, ASSOCIATED PRESS (Sept. 27, 2007). China has also indicated that its demolition of a space satellite was to let the United States know that it would not tolerate space-based weapons. Making Russia and China partners could reduce the potential for a new space race while making use of the great wealth of experience and scientific knowledge in the Russian and Chinese portfolios.

[42] A. Farand, *Space Station Cooperation Framework*, 94 ESA BULLETIN 3 (May 1998).

> and control over such object, and over any personnel thereof, while in outer space or on a celestial body.
>
> 2. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth.
>
> 3. Such objects or component parts found beyond the limits of the State Party to the Treaty on whose registry they are carried shall be returned to that State Party, which shall, upon request, furnish identifying data prior to their return.[43]

This treaty establishes the principle that the management of and jurisdiction over objects put into outer space remains with the State that owns the objects. This provides for both the basis of terrestrial tort liability for accidents and the return of objects to their State owner. However, in light of the steady pace of space missions launched by a variety of States and private entities and the anticipated growing number of robotic missions to Mars, missions are increasingly shifting from single State and private involvement in space stations and colonies to a sharing of resources and equipment. Thus, new agreements will require multilateral components and liability sharing provisions.

A multilateral agreement for Mars exploration should require governmental and/or private entities that participate in and benefit from space activities to accept technology sharing and, ultimately, a possible limited, shared liability structure. It is still debatable how to share such ownership responsibility and which aspects should remain with the relevant State in terms of supervision.

In addition to IGAs there are several MOUs that need to be drawn up. COPUOS, or an International Mars Space Committee (IMSC) under the legal guidance of COPUOS, should address judicial review and the means to safeguard the integrity of in-

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[43] Outer Space Treaty, *supra* note 5, at art. VII.

ternational agreements on the control of operations on a trip to Mars. The Committee would provide political guidance as an international body to better orient international cooperation and technology transfer. An open and transparent agreement would remove the need for a strong enforcement and interpretive body at the outset, but for such a document to retain its binding legal force over the several decades needed for development of long-term mission goals, such an oversight body will be necessary. Early agreements should strive for some technical specificity, but should also create working principles that anticipate such issues as future participation by Nation-States as well as private entities, methods for resolving conflicts including international arbitration proceedings and require long-term commitments from participants that will ensure its ongoing nature.

The right of any State to develop outer space technologies is, in principle, unquestionable. In practice, difficulties continue to center around technological development and technology sharing, especially when the equipment has both civil and military application. Any technology transfers must therefore consider the relevance that access to these technologies will have on global security.

III. TECHNOLOGY TRANSFER AND INTELLECTUAL PROPERTY PROTECTION

The focus of multilateral teamwork crosses traditional supplier/recipient relationships. Co-operation on transfer issues especially must be reinforced by agreements that embrace the Openness Principle and thereby ensure transparency and predictability on issues directly affecting the security and development of individual States or groups of States.[44]

Space technology transference and sharing agreements apply directly to equipment, applications, and services between suppliers and recipients. However, outer space, beginning with the question of the difference between outer space and air space,

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[44] *See* dual-use nuclear agreements such as the Nuclear Proliferation Regime run by the Nuclear Suppliers Group; *see also* benchmarking programs that encourage and foster open participation and self-monitoring (i.e. Australia's nuclear program).

is not particularly intuitive to legal scholars. UN documents make clear that no nation may appropriate outer space for its own, while nations may claim sovereignty over the airspace above their terrestrial borders. This makes the issue of where airspace ends and outer space begins highly contentious. Scientists note that outer space begins approximately 90-110 km above the Earth's surface.[45] Legal regimes, however, have stalled on whether to use a functionalist approach (outer space is defined by the sorts of activities taking place in it) or a "spatial theory" approach (outer space boundaries begin at a certain altitude).[46] Diplomatic attempts to define space boundaries have been largely unsuccessful – the Soviet Union in 1979, 1983, and 1987 attempted to model the legal definition on the scientific and proposed the spatial theory at somewhere between 100 and 110 km above the Earth.[47]

Pertinent to this article are the definitions of near-earth orbits such as LEOs which function at 500 and 1,500 km above Earth, MEOs which function at 5,000 to 12,000 km above Earth, and GEOs at 36,000 km above Earth.[48] This variation of boundaries creates the need for legal definitions and rules that will apply to particular operations and technologies at varying distances from Earth – it may not be enough to treat any location outside the Earth's atmosphere as "outer space" for legal purposes when technological, scientific, and economic realities define boundaries in a finer level of detail.

Without strong legal categories in place, agreement signatories must work backward such that any technologies that function at GEO level or beyond such as on the Moon and other celestial bodies, are to be considered outer space technologies, e.g., rocket boosters, satellites and their components, and Earth-

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[45] Bin Cheng, *The Legal Regions of Airspace and Outer Space: The Boundary Problem,* 5 ANNALS OF AIR & SPACE L. 323-356 (1982).

[46] A. Patterson, New Space Technology: Regulatory Challenges for the International Telecommunication Union, 5 (1998) unpublished LL. Master's thesis, McGill University Institute of Air and Space Law), *available at* http://www.collectionscanada.ca/obj/s4/f2/dsk1/tape10/PQDD_0026/MQ50957.pdf.

[47] *Id.*

[48] Alexander Keller, *Towards CORBA-based Enterprise Management: Managing CORBA-based Systems with SNMP Platforms*, SECOND INTERNATIONAL ENTERPRISE DISTRIBUTED OBJECT COMPUTING WORKSHOP: EDOC'98 (Nov. 1998).

based control and tracking systems. Critical infrastructure subsystems contributing to these applications that go into space could be considered "related outer space technologies," making the ultimate destination of the mission the ultimate arbiter of legal jurisdiction.[49] Another option would follow the spatial theory approach, with jurisdiction and liability apportionment changing based on the location of the technology – thus, a mission going into GEO and beyond would pass through multiple jurisdictions along the way.

The question of restructuring outer space technology transfer is irrelevant without a better understanding of the present relationship among States and a firm definition of where sovereign airspace ends and outer space begins. The quest for improved relationships in respect of technology transfer must first start with an assessment of the political, military, technical, and economic implications of outer space technologies.

The United States is the country with the largest, and perhaps most comprehensive national legislation among the major suppliers of outer space technologies, and it aggressively seeks to maintain its ownership and intellectual property rights for its technology. The United States is also among the most protective of dual use technologies, and in an era of increasing nuclear proliferation and the possible militarization of space, this protectiveness is likely to increase.

The ESA's own rules and procedures indicate that it may propose specific provisions to protect Member States' interest and its own objectives with regard to technology transfer from State to State.[50] According to its current rule system, ESA must inform Member States of pending or proposed technology transfers. Member States are then given six weeks to request a delegate meeting if they judge that the proposed transfer needs to be examined.[51] If a delegate meeting is required, the transfer requires a two-thirds majority of all Member States for approval, depending on the case. An account of the transfer is made and included in the Agency's Director General Report to

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[49] *See supra* note 34.
[50] *Id*.
[51] *Id.*

Council and to the Committee on transfers of inventions, technical data, and assets, thus ensuring some degree of transparency of the knowledge of requests for transfers.[52] This may provide a model for other State space agencies to participate in technology transfers.

Another key potential sticking point in these arrangements is the protection of domestic and international patents. Use of the Openness Principle can help give private industry the confidence necessary to develop space technology that will be used in multilateral joint ventures. The participants in multilateral space exploration agreements can build clarity into contracts and agreements with regard to the application of international intellectual property law in securing proprietary rights in space activities while providing a trade-off in terms of knowledge gain and access to new uses for these technologies. This creates transparency and protects intellectual property.

In the most beneficial scenario, supplier States would realize that the spirit of international outer space exploration is based on the stimulation of cooperation – that large-scale exploration, including applications for new technologies and the discovery of new resources, will be limited without international joint ventures.[53] The possibility of developing technology synergies that will only emerge through cooperation and the possibility of sharing in the benefits of and discoveries from space exploration for private companies and State-sponsored space agencies alike should create a drive for equal access to technologies and, in some cases, a sharing of rights.

In terrestrial private property regimes, property is a commodity belonging to an individual, institution or State who owns the rights to use, exclude others from or dispose of it how they

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[52] *Id.*

[53] One's hope that private firms may also be taken up by the "spirit" of the enterprise fades when one notes that the duties of corporate officers and directors to the corporation are fiduciary in nature and thus it is a violation of those duties to use the corporate entity for purposes not expressly linked to making a future profit. However, if there can be a showing that either a) such technology sharing will, in the end, create a financial benefit (or the chance of one) or b) at the very least not impose a cost (i.e., the technology transfer is not into a "market"), this fiduciary duty may not be implicated.

see fit.[54] In a free international community, a given commodity may be sold, transferred or provided in any other way to a third party only according to the owner's free will. Those involved in technology transfer can be individuals, private firms, States, or any other type of enterprise. Technology developed by a State, for example, is also a commodity and hence a State's property. Therefore, a State can, of its own will, decide whether or not to supply this technology in the international market.[55]

IV. PRIVATE LAND CLAIMS

Several international instruments have abandoned the "first come, first served" principle with regard to cross-boundary natural resources in favor of "equitable access" to natural resources especially with regard to the developing world where resource access can often be a life or death situation for citizens.[56] There is still, however, much to be done to increase access equity. The examples on Earth such as water rights from transboundary flowing rivers and air and water pollution that moves through transboundary basins, can inform natural resource decision-making in and for the space frontier before it becomes a problem of wealth and scientific knowledge distribution.[57]

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[54] *See, e.g.*, STANFORD ENCYCLOPEDIA OF PHILOSOPHY ("[p]rivate property" refers to a kind of system that allocates particular objects like pieces of land to particular individuals to use and manage as they please, to the exclusion of others (even others who have a greater need for the resources) and to the exclusion also of any detailed control by society.") This is the definition of property that is more or less in use throughout the world's property regimes.

[55] Jannat C. Thompson, *Space for Rent: The International Telecommunications Union, Space Law, and Orbit Spectrum Leasing*, 62:1 J. AIR L. & COM. 279 (1996).

[56] *See* International Telecommunication Convention, ch. III, art. 33 Nov. 6, 1982, S. Treaty Doc. No. 99-6 (discussing radio frequencies and the geostationary satellite orbit); *see also* African Convention on the Conservation of Nature and Natural Resources, art. IX Sept. 15, 1968, 1001 UNTS 3 (discussing genetic resources and species biodiversity).

[57] There is an increasing body of national institutional support for helping impoverished peoples and nations keep their access to resources developed in their properties. The International Development Research Centre in Canada and the US Department of Agriculture through its Conservation Security Program (CSP) have funded programs devoted to providing and maintaining resource access for local peoples and tribes at home and abroad. *See*, Environmental and Natural Resource Management, *Enhancing Equitable Access and Use Rights*, http://www.idrc.ca/en/ev-81162-201-1-DO_TOPIC.html (last visited May 16, 2009) and United States Department of Agriculture Natural Re-

With regard to space orbits and the potential exploration of celestial bodies, access to land areas for human research or settlement requires expanding and putting in place "equitable access" agreements, especially for both basic and applied scientific research. Equitable access provisions would provide for special areas or "zones" for research where the term "access" does not grant ownership. We note the term "access" does not create ownership of a position or segment of the orbit in the space frontier, but only gives the possessor the right to use it. In balancing equitable access, efficiency, and the needs of the developing countries, the authors of this paper have suggested in previous publications that the creation of a tax-free "economic zone" or "research zone" on Mars could be the key to how a few hundred inhabitants from a score of Earth Nation-States could maintain a multilateral balance covering tens of thousands of hectares on Mars.[58]

A multilateral agreement should set forth the necessary attributes of an efficient and equitable approach to respect the property of celestial bodies – notably Mars and the Moon – as a common property that cannot be claimed by any one State or consortium of multinationals doing research on a spacecraft or on the surface or subsurface of celestial bodies. However, such a system of multilateral management must provide for the allocation of rights, and the power to exclude, use, and dispose of property interests. All of these rights require the protection of sovereign power for the provision of which the Nation-State has been developed and is suited according to space laws that have been evolving since 1967. The current and developing space property laws and adjoining issues of liability are not completely incompatible with such a system, but are vague and in-

sources Conservation Service, *Conservation Security Program,* http://www.nrcs.usda.gov/programs/csp/ (last visited May 16, 2009). These programs range from equitable access to farmland to freshwater. The United Nations program Secure and Equitable Access to Land (SEAL) has similar goals for sub-Saharan Africa. *See* Partnerships for Sustainable Development, *Secure and Equitable Access to Land,* http://webapps01.un.org/dsd/partnerships/public/partnerships/23.html (last visited May 16, 2009).

[58] James Hurtak & Matthew Egan, *Consequences for Space Law-Making of Water Discovery on Mars*, 29 ANNALS OF AIR & SPACE LAW 393-422 (2004).

consistent with respect to new situations, e.g., competition for water resources on a foreign planet, finding of other life forms, extraordinary events, etc. This could be because such events, until the recent press releases regarding the strongest evidence to date of flowing water on Mars and the tantalizing possibility that such a potential discovery will yield a biological historical record in the form of fossils, had seemed farfetched. It seems time to be ahead of the curve in developing an environmental and research agenda that will provide adequate protections and still create incentives for exploration.

We believe a very good strategy would be to amend existing laws and, by treaty, explicitly approve a system of multinational rights – such a system could apply only to space travel or could, more generally, become positive international law. Better yet, however, due to the gamut of issues and the new terminology needed for possible near-Earth orbital zones and environmental protection zones for Martian resources,[59] we suggest a series of new agreements with a framework of responsibilities, trade-offs, and language that sets forth a research and policy agenda that provides for information-sharing and environmental protection. Such a course of action would highlight the importance of Mars and the Moon as future exploration zones and would be based on the concept of "reasonable use" of Martian and lunar properties as a basis for protecting national and non-national property rights and govern property appropriation issues.

V. CROSS-WAIVERS OF LIABILITY

The notion of "absolute" or "strict" liability, the duty to compensate not subject to exoneration or a determination of fault, has become an important part of space launch and exploration.[60] Without relying on the traditional notions of fault or

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[59] *Id.*

[60] Sections 519 and 520 of the Restatement (Second) of Torts define strict liability for "ultrahazardous activity" a standard adopted by many of the states in the United States. Section 519 provides: (1) One who carries on an abnormally dangerous [or ultrahazardous] activity is subject to liability for harm to the person, land or chattels of another resulting from the activity, although he has exercised the utmost care to prevent the harm. (2) This strict liability is limited to the kind of harm, the possibility of which makes the activity abnormally dangerous. Section 520 contains a list of "the factors to be

negligence, recent instruments provide for certain exceptions to liability resulting from acts of God.[61] The Convention on International Liability for Damage Caused by Space Objects (hereinafter "Liability Convention") was the most important document for establishing a system for apportioning liabilities for accidents regarding space activities.[62]

Under the Liability Convention, if a space object causes damage on the surface of the Earth or to aircraft in flight, absolute liability attaches to the launching state.[63] This is based on the notion that space launch involves "ultrahazardous activity" a rule of tort law that requires that entities that engage in activities that entail potential harms that cannot be mitigated are strictly liable for the harms they cause.[64] The launching state is defined as the "State which launches or procures the launching of a space object . . . [or] . . . a State from whose territory or facility a space object is launched."[65] In cases of accidents occurring in outer space or Earth orbit ("elsewhere than on the surface of the Earth"), liability is determined by fault. If there is more than one launching state, joint and several liability exists

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considered in determining whether an activity is abnormally dangerous." RESTATEMENT (SECOND) OF TORTS § 519, comment b (1997). These factors include the risk of harm, its likely scope, ability to eliminate the risk, whether the activity is uncommon, whether the activity is inappropriate to a particular place, and the value of the activity. Moore v. R. G. Indus., 1984 U.S. Dist. LEXIS 24010 (N.D.Ca.1984); *see also* Manfred Lachs, *Challenge of the Environment*, 39 INT'L & COMP. L.Q. 663 (1990); Manfred Lachs, *Views from the Bench: Thoughts on Science, Technology, and World Law*, 86 AM. J. INT'L L. 673 (Oct. 1992) [hereinafter *Views from the Bench*]; M. Spada, *Risks of space market and liability in commercial space ventures,* IEEE AEROSPACE CONFERENCE 159-166 (Mar. 5-12, 2005); Henri A Wassenbergh, *International Space Law: A Turn of the Tide*, 22 AIR & SPACE LAW 334, 339 (1997).

[61] Paris Convention on Third Party Liability in the Field of Nuclear Energy, July 29, 1960, 956 U.N.T.S. 251 [hereinafter 1960 Paris Convention]; Brussels Supplementary Convention to the Paris Convention on Third Party Liability in the Field of Nuclear Energy, Jan. 31, 1963, 1041 U.N.T.S. 358; Vienna Convention on Civil Liability for Nuclear Damage, May 21, 1963, 1063 U.N.T.S. 265.

[62] Explicit cross-waivers of liability with regard to the Space Station Freedom were adopted in the United States in 14 C.F.R. § 1266, et. seq.; *Views from the Bench*, *supra* note 60.

[63] Lara L. Manzione, *Multinational Investment in the Space Station: An Outer Space Model for International Cooperation?,* 18 AM. U. INT'L L. R. 507 (2002).

[64] GLENN H. REYNOLDS & ROBERT P. MERGES, OUTER SPACE: PROBLEMS OF LAW AND POLICY 303 (2d ed. 1997).

[65] Manzione, *supra* note 63.

between or among them, and a standard of comparative negligence may be employed, if appropriate.[66]

Reading the Liability Convention in concert with the Outer Space Treaty requires State liability for all activities in outer space, whether undertaken by governmental, non-governmental organizations, or private entities acting within their territory. A State may thus be liable for the acts of a corporation registered in its territory that procures a launch in a different State, irrespective of the host State's knowledge or involvement in the launch.[67] This creates incentives for States to either regulate the commercial launching enterprises located within their boundaries or to monopolize space launch and exploration.

Commentators have suggested that the absolute liability inhering from the Liability Convention makes private investment in space exploration too risky. In order to promote space exploration, use, and investment, governments have allowed entities to use cross-waivers to contract around the liability requirements, at least as they stand between contractors, subcontractors, users or customers, and suppliers of any kind. A good example of this is contained in Article 16 of the IGA, which reduces liability in and between participating States and their contractors.

The Liability Convention applies to situations not specifically covered by the cross-waiver and requires claimants to present their claims through diplomatic channels. The extent of liability is to "be determined in accordance with international law and the principles of justice and equity."[68] This is to say that while participants in a joint venture can contract with one another regarding personal liability, they cannot contract around international law that holds them absolutely liable for damage done to non-participants or the public.

Cross-waivers provide protections against liability between participants, thus greatly reducing the risk of liability between partners and their contractors. NASA agreements involving

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[66] *Id.*
[67] *Id.*
[68] Mary B. McCord, *Responding to the Space Station Agreement: The Extension of U.S. Law into Space*, 77 GEO. L. J. 1933 (1989).

Space Shuttle flights are required to contain broad cross-waivers of liability among the parties and their related entities to encourage participation in space exploration, use, and investment. The purpose of this clause is to extend this cross-waiver requirement to contractors and related entities under their contracts. This cross-waiver of liability is broadly construed under US domestic law to achieve the objective of encouraging participation in space activities.[69]

The cross-waiver utilized by the Space Station Agreement is similar to that used by NASA in its Launch Service Agreements with private commercial entities.[70] It requires partners to waive all claims against other partners, their related entities, or employees of the other partners or their related entities, for damage arising out of protected space operations. For purposes of the Space Station Agreement, protected space operations include "all launch vehicle activities, Space Station activities, and payload activities" whether they occur "on Earth, in outer space, or in transit between Earth and outer space," as long as these activities are conducted in furtherance of implementing the Space Station Agreement.[71] Protected space operations do not include "activities on Earth which are conducted on return from the Space Station to develop further a payload's product or process for use other than for Space Station related activities."[72]

> The cross-waiver does not apply to:
> (1) claims between a Partner State and its own related entity or between its own related entities;
> (2) claims made by a natural person, his/her estate, survivors, or subrogees for injury or death of such natural person;
> (3) claims for damage caused by willful misconduct;
> (4) intellectual property claims.[73]

Since these exceptions create openings for future claims for which the Space Station Agreement does not provide guidelines, future cross-waiver provisions for joint ventures in space explo-

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[69] NASA F.A.R. Sup. 5228-41.
[70] *See* McCord, *supra* note 68.
[71] *Id.*
[72] *Id.*
[73] *Id.*

ration should be modified to be as inclusive of new situations as possible.

Adequate cross-waiver provisions for international joint ventures for a Mars expedition or other space exploration should be based in part on the NASA and the Space Station Agreements' cross-waivers, but should either be modified to account for the issues raised by several commentators cited above, or COPUOS or another of the UN space governing bodies, such as the International Mars Space Committee (IMSC) suggested below, should be responsible for apportioning liability between partners in space faring activities that fall outside the specific contract provisions of the cross-waivers.

Cross-waivers should also not be extended by international instrument to deprive innocent parties of just compensation for accidents they had no part in creating. Thus, if a space mission is lost shortly after takeoff and natural people are, for example, injured by debris or nuclear fallout, absolute liability should inhere. Having a rule of absolute liability for those injured by space launch accidents or returns creates a strong incentive for safety and works to protect people from accidents over the long term. If participating governments want to reduce liability, they can indemnify the entities that participate in launch activities up to a certain liability level as the United States had done with nuclear power plant operations.[74] This is a subsidy of sorts, but if practiced carefully, it can also work to increase mission safety.

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[74] An example of this is the United Sates' Price-Anderson Act (42 U.S.C. § 2210). The Price-Anderson Act requires civilian nuclear power companies to purchase the maximum amount of insurance available to them (roughly $300 million). Then, the civilian nuclear power companies are each liable for an amount that would be paid into a fund in the case of an accident. Currently, the contributions are roughly $100 million and the fund itself is roughly $10 billion. Beyond that, the United States government agrees to indemnify the nuclear industry for the cost of an accident above and beyond the $10 billion threshold. The Act has been criticized as a subsidy on the cost of safety for nuclear power plants, but was used as a way of stimulating civilian production of nuclear power. The United States Supreme Court upheld the Act's constitutionality in Duke Power Co. v. Carolina Environmental Study Group, 438 U.S. 59 (1978). In *Duke Power*, the Court held that the Act bore a rational relationship to the goals sought by Congress, namely to support the development of nuclear power. This overrided the fact that the indemnification agreement would subvert victims' tort claims and treat them differently than other industrial accidents.

VI. Identifying a Negotiating Forum

Our proposals for a multilateral agreement would also call for the establishment of an International Mars Space Committee (IMSC). Establishing this Committee in a non-partisan area venue like the United Nations for major negotiations would expand the multilateral context of decision-making used for outer space technologies and exploration. The UN permanent Committee on the Peaceful Uses of Outer Space (COPUOS) in Vienna, Austria, we believe, should be the origin of the IMSC.

Even given the longstanding worries about submitting civil matters to an international institution, creating an organization like the IMSC and allowing it jurisdiction over civil, environmental, and biological affairs (if any) on Mars would be a step toward having a governing body of scientists, policy-makers, and explorers in place before arrival. This would create an environment for exploration within a legal framework and with the Openness Principle at the heart of international instruments, would also create a cooperative working arrangement between participants.

VII. Non-proliferation of Military Technology and Security Issues

There is a growing necessity to guarantee the security of all participating States that have renounced the possession of delivery of military technologies into space that could lead to the eventual weaponization of Mars and/or the Moon. An incentive mechanism for States to renounce the movement of weapons into space could include:

a) An international monitoring committee to observe and resolve technology and confrontational issues that might arise, probably governed by COPUOS;

b) Either a requirement that participants renounce weaponization of outer space, including any future landings on or settlement of Mars, or a system that allows full resource-sharing and other benefits to come from such a renunciation;[75] and

c) International assistance in the development of bases and settlements on the Martian frontier so long as they do not contain weapons of any sort.

For multi-national space expeditions, each Party would have to agree on a common list of items and recipients that would be consistent with regional and international security concerns. A human mission to Mars should not allow any nation the opportunity to develop military capacity in the space mission, particularly capacity that could lead to military dominance or control of resources. This would keep in line with the 1967 Outer Space Treaty and would relax possible worries that some nations may have about ulterior motives for space exploration. A joint venture involving former or potential military rivals, as many of the EtSC states are, could be scuttled by the possibility that one nation would seek to dominate others by controlling the near space regions around the Earth. Any multilateral agreement on this subject would require transparency to ensure that shared dual-use technologies would not be misused and that all participants would be comfortable with the other nations' positions. Many multilateral arms agreements have allowed some oversight by rival nation's inspectors or respected third parties; in this case COPUOS seems an ideal organization to provide such oversight, especially because of its physical and philosophical proximity to the International Atomic Energy Agency. These agreements could be used as a baseline to ensure that the joint venture could not be used for ill motive by

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[75] This could be based on agreements such as those promulgated by the Nuclear Suppliers Group, which lays out guidelines for methods by which Nuclear States can trade both nuclear and non-nuclear materials with non-nuclear states. Essentially, this is a trade organization that works to reduce nuclear weapons proliferation while helping non-nuclear states develop civilian nuclear power. The NSG guidelines are located in: *Guidelines for Nuclear Transfers*, INFCIRC/254, Part 1, and *Guidelines for Transfers of Nuclear-Related Dual-Use Equipment, Materials, Software and Related Technology*, INFCIRC/254, Part 2.

any of its participants and could remove potential problem areas before they arose.

CONCLUSIONS

The increasing drive to privatize, commercialize, and promote outer space activities operating in and out of the Martian planetary environment needs to be addressed by the international community before it becomes a regular reality. We are in the position now of being able to look forward fifty years and see that human exploration of, and even potentially human settlement, on Mars and the Moon will be a likely reality. To that end, it is important to create a legal framework for exploration, liability allocation, environmental protection, property regimes, natural resource allocation, biological archaeology protocols and information sharing, and scientific research, before the status quo of no legal rules has been set.

To satisfy this need, the space community should be drafting preliminary international agreements to standardize requirements for governmental entities that intend to become active on Mars. In 2008, the *Phoenix* spacecraft landed on Mars' North Pole to search for water and organic molecules, only months after solid evidence had emerged that water has been flowing on the Martian surface within the last five years.[76] In 2009, the most ambitious mission in the queue, the mobile *Mars Science Laboratory (MSL)* will launch with a very impressive payload of experiments. The *MSL* will travel a kilometer or more from its landing site carrying a suite of sophisticated instruments for sniffing out the chemical evidence for a biological record of "life" on Mars. These missions, with a host of others to follow, will pave the way for astronauts to visit Mars within the next several decades.

By its very nature, space exploration shrinks distances both extraplanetary and intraplanetary, integrating disparate cultures, economies. Hopefully, the shared understanding that, as

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[76] *See* NASA, *NASA Images Suggest Water Still Flows in Brief Spurts on Mars* (Dec. 6, 2006), *available at* http://www.nasa.gov/mission_pages/mars/news/mgs-20061206.html.

we go into space, we are one human race rather than many disparate and competitive States, will facilitate a peaceful, prosperous, and cooperative global order. Like globalization, space travel will continue to create interdependence among nations and peoples of the world. Space, we believe, will also transform the meaning of the term multilateral, with major governmental, trans-national corporations and international consortia playing roles once reserved exclusively for governments. Space, too, has become increasing important as a venue for realizing our most challenging aspirations for prosperity on Earth – economic and environmental. The lessons learned from the challenges of space exploration can teach us about the ways in which we should think about governing ourselves at home. Multilateral agreements may, in the end, be seen to work effectively and efficiently to allocate the technology and natural resources on our planet and those in space.

REGULATORY CHALLENGES, ANTITRUST HURDLES, INTELLECTUAL PROPERTY INCENTIVES, AND THE COLLECTIVE DEVELOPMENT OF AEROSPACE VEHICLE-ENABLING TECHNOLOGIES AND STANDARDS: CREATING AN INDUSTRY FOUNDATION

René Joseph Rey[*]

ABSTRACT

Decades ago, aircraft manufacturers openly shared their intellectual property (IP), without regard for antitrust concerns, through a National Advisory Committee for Aeronautics (NACA) sponsored technology transfer agreement. IP-openness led to the essential market-enabling technologies needed for commercial aircraft development. Today, small aerospace firms believe they are on the threshold of opening new space-based industries in space tourism, low-cost satellite launching, same-day package delivery, and rapid point-to-point passenger travel. The key to opening these new markets is the development of enabling and sustaining technologies that will provide the equivalent breakthroughs in operability for aerospace vehicles that IP-sharing provided for aircraft in the nascent commercial aviation industry.

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Present-day investors are reluctant to finance small aerospace firms developing new aerospace vehicle concepts because of the Government/Large-Aerospace-Firm boycott. As members of this boycott, the four largest aerospace firms receive billions of dollars from NASA, without risk to investors, for merely "studying innovative ways" to perpetually evolve government-sponsored, intercontinental ballistic missile (ICBM)-derived launch vehicles—not developing market-enabling technologies for commercial aerospace vehicles.

This thesis will explore the role IP incentives can play in fostering the development of aerospace vehicle-enabling technologies and flightworthiness standards. Modern cross licensing, patent pooling and cooperative standard setting doctrines should be examined within the context of a five-point "alternative strategy" to create incentives for small-scale innovators to introduce the requisite technologies and standards. These market-enabling technologies and standards are integral to the commercially operable aerospace vehicles that are essential for opening new space-based markets.

INTRODUCTION

The "New Space" industry is defined as "private industry initiatives supporting human spaceflight and the eventual human habitation of locations outside of Low Earth Orbit."[1] The industry is not only limited to the areas of human spaceflight and habitation, but includes the supporting infrastructure (e.g., communication, power, transportation, etc.) that is necessary for enabling and expanding the human presence in space.[2] This thesis, however, is only concerned with the commercial space transportation (CST) aspects of the New Space industry[3]—more specifically, the advent of commercially viable aerospace vehi-

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1 Mary Lynne Dittmar, President & CEO, Dittmar Associates, Inc., *A Framework for Government-Commercial Economics in the New Space Industry,* address at the AIAA Space 2006 Conference, San Jose, California (Sept. 19, 2006).

2 *Id.*

3 Leading industry figures in the area of human spaceflight with an eye toward eventually providing point-to-point space transportation services include Virgin Galactic, which is working with Burt Rutan's Scaled Composites, L.L.C., to begin commercial suborbital tours by 2010–2011; XCOR Aerospace; and Rocketplane Global.

cles and point-to-point space travel.[4] The commercial viability of aerospace vehicles will depend on the market need for point-to-point space transportation,[5] as well as the development of future technologies and regulatory frameworks.

Today, members of the New Space CST industry believe they are on the threshold of opening new space-based industries in space tourism, low-cost satellite launching, same-day package delivery, and rapid point-to-point passenger travel. But to be commercially viable, New Space aerospace vehicles will have to evolve into globe-spanning space transportation systems that function within an international regulatory framework. This framework, in turn, will require these vehicles to possess the robust structures and subsystems necessary for safe, reliable operations. One of the key obstacles to opening the New Space CST markets will be the development of enabling and sustaining technologies that will provide the equivalent breakthroughs in operability for aerospace vehicles that large amounts of government investment provided for aircraft in the nascent commercial aviation industry.

The National Advisory Committee for Aeronautics (NACA), founded in 1915, directly supported civil aircraft research and development (R&D) through a series of aeronautical innovations that helped establish the U.S. aviation industry.[6] Aircraft manufacturers also openly shared their IP, without regard for antitrust concerns, through a NACA-sponsored technology transfer agreement beginning in 1917.[7] NACA-sponsored R&D, in concert with IP-openness, led to the essential market-enabling technologies needed for commercial aircraft development. Al-

[4] The term: "Aerospace Vehicle," is defined as a vehicle capable of flight within and outside the sensible atmosphere. The vehicle's attributes include maximum reusability with minimum refurbishment such that it is capable of taking off from, and landing on, land under aircraft-like control conditions. In addition, the vehicle is adaptable to carrying a varying number of crew members and passengers, or carrying a substantial cargo. In addition, such a vehicle may be adaptable to other space missions, such as, for example, satellite delivery to orbit. *See* U.S. Patent No. 3,576,298 (filed Nov. 13, 1967) (issued Apr. 27, 1971).

[5] Here, point-to-point space transportation includes travel between two different locations on Earth, between the Earth and Earth orbits, and in Earth orbits.

[6] Dittmar, *supra* note 1.

[7] George Bittlingmayer, *The Application of the Sherman Act to the Smog and Aircraft Patent Agreements* 22, (FTC Bureau of Economics, Working Paper No. 120, 1985).

though NACA was the predominant government agency supporting civil aircraft R&D, the Air Mail Service of the U.S. Post Office represented the largest number of federal dollars directed toward the development of the commercial aviation market:[8]

> . . . [T]hrough the Kelly Act,[9] the Postmaster General of the United States was empowered to award contracts for carrying airmail to private airlines. The Post Office expanded the domestic route system by avoiding competition on individual routes and by awarding contracts to fly specific routes in a successful effort to streamline and rationalize the industry. By 1933, the "Big Four"—United, American, TWA, and Eastern—collected nearly 94 percent of the $19.4 million paid to airmail carriers. Passenger transport eventually took hold, and by 1935 the Big Four were carrying people, cargo, and the mail along established routes.[10]

Under the Kelly Act, airways, airports, weather stations, strings of electric light beacons, and a new system of radio navigation were also constructed to spur private investment, and thus forge a national system of air transportation.[11]

Clearly, the U.S. Federal Government "invested" in the development of commercial aviation because there was a market for going "somewhere to somewhere."[12] A fundamental issue for the New Space CST industry, however, is whether there truly is a sustainable market for its services.

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[8] Deborah G. Douglas, *Three-Miles-a-Minute: The National Advisory Committee for Aeronautics and the Development of the Modern Airliner, in* INNOVATION AND THE DEVELOPMENT OF FLIGHT 154 (Roger D. Launius ed., 1999).

[9] The Kelly Air Mail Act (Contract Air Mail Act) of 1925. Prior to the Kelly Act, the U.S. Post Office delivered air mail using its own aircraft in a developmental program involving the U.S. Army. *See* Policy Dimensions of Manned Suborbital Commercial Spaceflight 83 (2008) (unpublished undergraduate project course final report, Carnegie Mellon University) (on file with the Carnegie Mellon University Department of Engineering and Public Policy) [hereinafter Policy].

[10] Dittmar, *supra* note 1.

[11] Douglas, *supra* note 8, at 154.

[12] *Id*.

MARKET NEED

New Space CST industry members face not only major technological and regulatory hurdles, but they must also seek low-risk, investor-friendly business models that provide the flexibility to cope with market uncertainties.[13] Significant uncertainties include how market demand changes with price, the cost of regulatory compliance and other safety measures, and the impact of accidents on future revenue.[14] In the absence of direct government investment, these hurdles and uncertainties have led CST companies like Virgin Galactic, XCOR, and Rocketplane Global to limit their planned services to "adventure suborbital space travel"—often referred to as "space tourism"—with the express goal of leveraging suborbital experience into point-to-point space transportation services.[15]

Unfortunately, there is a large cloud of uncertainty surrounding consumer demand for adventure suborbital space travel. Since the early 1990's, many studies have emerged examining potential demand, price elasticity, and various customer preferences. The most recent of these studies, conducted by the Futron Corporation, gauged the response of 450 affluent Americans in 2002 to forecast the demand for suborbital space travel.[16] Although the study found that market segments targeted by space tourism companies will be high net worth individuals capable of paying high prices for adventure travel,[17] it also concluded that these companies face a number of obstacles

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[13] R. Stephens, *How to Finance and Develop an RLV [Reusable Launch Vehicle] Industry,* address to the First World Summit on the Space Transportation Business, Paris, France (May 10, 1999).

[14] Policy, *supra* note 9, at 46.

[15] Current plans for suborbital adventure flights envision a reusable spacecraft launched either vertically from the ground or horizontally from a carrier plane, a rocket-powered ascent to an altitude of 100 to 135 kilometers, and a return to the point of launch. Such flights would provide participants with about four minutes of weightlessness as the craft travels on a ballistic trajectory between rocket burnout and reentry to the atmosphere. *See* Policy, *supra* note 9, at 50.

[16] *See* S. Suzette Beard & Janice Starzyk, Futron Corporation, Space Tourism Market Study: Suborbital Space Travel (2002), *available at* http://www.futron.com/pdf/resource_center/white_papers/STMS_Suborbital.pdf .

[17] Of the high net worth individuals in their survey, 51% of the respondents would be willing to pay $25,000 while only 30% would pay $100,000 and only 18% would pay $200,000. Policy, *supra* note 9, at 53.

in their efforts to turn planned and prototype vehicles into operational vehicles. Specifically:

> In addition to the technical obstacles associated with any new aerospace vehicle, passenger spacecraft may face major regulatory hurdles, depending on their nation of operation . . . The biggest obstacle, however, appears to be financial, as companies struggle to raise the funding needed to build their proposed vehicles. Much of the difficulty stems from the inability to demonstrate that there is a sufficiently large market for space tourism to attract the investment needed to develop vehicles that can service this market.[18]

Virgin Galactic's Conundrum

Launched in September 2004 by Sir Richard Branson,[19] Virgin Galactic will invest up to $250 million of its own capital to build, test, and fly five suborbital spacecraft and two carrier aircraft.[20] In fact, Virgin Galactic is the only space tourism company with actual flight hardware under construction.[21] So far, more than 250 people from 30 different countries have made firm reservations to fly with Virgin Galactic, and 80 have al-

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[18] Beard, *supra* note 16, at 6.

[19] British billionaire Sir Richard Branson is a famous entrepreneur and founder of the international brand, Virgin. He is known best for his successful companies under the "Virgin" brand name and their products. He is also famous for his extreme world record breaking attempts. *See* Investing Value business and finance portal, *Sir Richard Branson Biography* (May 15, 2008), *available at* http://www.investingvalue.com/investment-leaders/richard-branson/index.htm.

[20] Virgin Galactic's vehicle is a two-stage-to-suborbit system comprising a suborbital spacecraft, the *SpaceShipTwo* (SS2); and a carrier aircraft, the *WhiteKnightTwo* (WK2). The SS2 is carried to an altitude of approximately 50 thousand feet by the WK2 and dropped prior to igniting its rocket engine and beginning its suborbital flight phase. *See* Press Release, Virgin Galactic, Virgin Galactic Showcases Its Investment in the Development of *SpaceShipTwo* (September 28, 2006), *available at* http://virgingalactic.com/pressftp/?content=Virgin%20Galactic%20Press%20Releases.

[21] However, in a recent press release, XCOR Aerospace claimed: "In a display of the power of competition, American entrepreneurs have broken the government monopoly on space travel, and succeeded in lowering the cost of space access *before a single paying participant has taken a flight*." Press Release, XCOR Aerospace, XCOR Aerospace to Announce Ticket Sales for Suborbital Space Flights (Nov. 25, 2008), *available at* http://www.xcor.com/press-releases/2008/08-11-25_XCOR_to_announce_suborbital_ticket_sales.html (emphasis added). Unfortunately, in the absence of an operational suborbital spacecraft, XCOR's claim lacks veracity.

ready begun training.[22] The company has banked $30 million in deposits, and claims that another 85,000 people have expressed interest.[23] Although Virgin is projecting 500 customers per year,[24] at $200,000 "for a [one-time] quick jaunt beyond the Earth's atmosphere and several minutes of zero gravity weightlessness," the Virgin adventure suborbital space tourism market doesn't appear to be a sustainable "market for the masses."[25] Rather, the Virgin suborbital market comprises a small niche of "actors, real estate magnates, hedge fund managers, and well-off adventurers,"[26] most of whom may not even be repeat customers. Given that Virgin Galactic's business model focuses on leveraging same-point–to–same-point space tourism into point-to-point space transportation, it is not evident that Virgin's required internal rate of return (IRR) will be high enough to not only amortize its initial $250 million investment, but to reinvest profits in the development of Virgin's next generation, point-to-point vehicles. Other factors affecting Virgin's potential point-to-point market include the negative impacts of a fatal suborbital vehicle crash, and the introduction of supersonic business jets.

Scaled Composites, L.L.C., the company designing and building Virgin Galactic's suborbital passenger spacecraft, is quick to point out that its vehicle will be safe. When questioned about the vehicle's safety during an interview with the Associated Press, the founder of Scaled, Burt Rutan, acknowledged that although the project has risks, his vehicle will be "hundreds of times safer" than government-funded space flight has

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[22] Newlaunches.com, *Kiruna – The first Virgin Galactic Spaceport* (Apr. 28, 2008), *available at* http://www.newlaunches.com/archives/kiruna_the_first_virgin_galactic_spaceport.php.

[23] *Id.*

[24] Frank Morring, Jr., *Commercial Spaceship Fleet Advancing*, AVIATION NOW (Dec. 11, 2006), *at* http://www.aviationnow.com/publication/awst/loggedin/AvnowStoryDisplay.do?fromChannel=awst&pubKey=awst&issueDate=2006-12-11&story=xml/awst_xml/2006/12/11/AW_12_11_2006_p46-48-01.xml&headline=Commercial+Spaceship+Fleet+Advancing.

[25] Emily Bazar, *Who's Paying $200,000 for a few minutes in space?*, USA TODAY (May 7, 2007), *at* http://www.usatoday.com/tech/science/space/2007-05-07-space-tourist_N.htm

[26] *Id.*

been to date.[27] However, questions about the suborbital spacecraft's safety were highlighted on July 26, 2007, when the spacecraft's engine exploded during a routine "cold flow" ground test using nitrous oxide, but without an ignition system.[28]

Furthermore, an examination of the flight history of government-funded experimental rocket-planes will reveal that out of 16 mostly distinct airframes, 10 were totally or largely destroyed in accidents.[29] Since two of these accidents would not have endangered passengers,[30] the relevant record for Scaled's suborbital spacecraft is: 8 life-threatening accidents in 458 flights, for a loss of 1-in-57 (1.75%).[31] This record is essentially the same as the *Space Shuttle*'s safety record.[32] The reason for this dismal safety record is that these rocket-planes combined four incompatible technologies:

- During ascent, they were ballistic missiles;
- At apogee, they were spacecraft;
- On descent they were reentry vehicles; and
- On approach and landing, they were gliders.[33]

Naturally, the result of these incompatible technologies was "a nightmare of complexity in which parts essential for one phase of flight were useless or even dangerous [during] the other phases."[34]

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[27] David B. Caruso, *Virgin Galactic unveils spaceship* (Jan. 24, 2008), *at*. http://www.usatoday.com/tech/products/2008-01-23-3049764844_x.htm.

[28] The test had been performed a number of times in the past without incident. *See* Spacetoday.net, *Fatal explosion at Mojave Airport* (July 27, 2007), *available at* http://www.spacetoday.net/Summary/3854. Three people died in the accident, and California occupational safety inspectors fined Scaled Composites $25,870 for unsafe conditions and failure to follow safety procedures during rocket motor testing. Investigators and the company's engineers are still trying to figure out exactly what went wrong. *See* Caruso, *supra* note 27.

[29] Jeffrey F. Bell, *Rocket Plane Roulette* (March 7, 2007), *at* http://www.spacedaily.com/reports/Rocket_Plane_Roulette_999.html.

[30] *Id.*

[31] *Id.*

[32] *Id*.

[33] *Id*.

[34] *Id*.

This "nightmarish complexity" became evident, once again, when Scaled's *SpaceShipOne*, the progenitor of Virgin Galactic's suborbital passenger spacecraft (known as *SpaceShipTwo*) suffered serious problems during all of its flights above 100 kilometers,[35] and was retired after only three flights.[36] Apparently, "Rutan didn't think that it was safe enough to fly passengers instead of sandbags—or even safe enough to make a few more proving flights to explore the economics of [Virgin's next generation suborbital spacecraft]."[37]

Taking into account Scaled's fatal rocket engine explosion at its test facility, *SpaceShipOne*'s serious high-altitude flight problems, and the dismal safety record of government-funded experimental rocket-planes,[38] it would appear that Mr. Rutan's

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[35] *SpaceShipOne* is inherently unstable, as evidenced by its loss of attitude control during its first X-Prize qualifying flight on September 29, 2004. The departure started when the angle of attack became slightly negative at Mach 2.7 and 120 KEAS (knots, equivalent airspeed at 120,000 feet). Directional stability dropped and the craft yawed about 8 degrees. Strong dihedral effect coupled the yaw into roll, and the nose pitched up about 15 degrees as well, starting a snap roll motion. *See* Michael A. Dornheim, *SpaceShipWon*, AVIATION WEEK (Oct. 10,2004), *at* http://www.aviationweek.com/aw/generic/story_generic.jsp?channel=awst&id=news/10114top.xml. A detailed analysis by Scaled Composites, L.L.C., determined that the rolls resulted from a mild thrust asymmetry, which could not be offset by pilot inputs at a flight condition of low directional stability. This flight condition had not been tested on previous flights. The low directional stability occurs only at high Mach numbers and at very low (zero or negative) angles of attack. The fix to this problem for the second X-Prize qualifying flight on October 4, 2004, was to fly a slightly less aggressive initial pull-up, which allowed the pilot to avoid the low angle of attack regime when at high Mach. According to Scaled, the characteristics of excessive dihedral effect and high-Mach low directional stability will be corrected on future spaceship designs, like *SpaceShipTwo* (Virgin Galactic's suborbital passenger spacecraft). *See* Scaled Composites Tier One Private Manned Space Program, *Combined White Knight / SpaceShipOne Flight Tests* (2004), *available at* http://www.scaled.com/projects/tierone/logs-WK-SS1.htm [hereinafter *Combined White Knight*]. *SpaceShipOne* also experienced structural buckling from aerodynamic stresses around the engine nozzle fairing during a test flight on June 21, 2004. However, this anomaly was brushed off by Burt Rutan's brother, a famed test pilot himself, who stated that the fairing could have fallen off completely without endangering the craft. The craft also experienced a flight control malfunction. Late in the boost phase, the craft's primary pitch trim control was lost. *See* David L. Chandler, *"Anomalies" in first private spaceflight revealed*, NEWS SCIENTIST (June 22, 2004), *available at* http://www. newscientist.com/article.ns?id=dn6052&print=true. *See also Combined White Knight*, *supra* note 35.

[36] *See* Bell, *supra* note 29.

[37] *Id.*

[38] Rocket-planes that were designed and operated by some of the best technical minds in the aerospace industry, and consumed thousands of hours of wind-tunnel test-

confidence in the safety of his latest creation is a bit overstated. When these factors are considered holistically, they strongly suggest that the probability of a fatal crash occurring within the first year of introducing Virgin Galactic's space tourism service is relatively high.[39] And, the impact of an early catastrophic crash on Virgin's space tourism market demand will be devastating. In fact, "the safety record of [government-funded] rocket-powered aircraft [alone,] suggests that the suborbital tourism industry is headed for a crash—and a lawyer feeding frenzy that will wipe it out."[40] And, because Virgin Galactic has linked its success in the space tourism market to eventually providing point-to-point space transportation services, the market demand prospects for Virgin's planned point-to-point space travel service do not look very promising, especially when there may be much safer, more cost effective alternatives available in the near future.

Technology Investment Gap

The New Space CST industry is plagued by a technology investment gap, as evidenced by the fact that not a single New Space suborbital spacecraft, whether proposed or prototype, is designed to meet FAA flightworthiness standards for carrying passengers.[41] And, merely encouraging the industry to compete for relatively small sums of money via contests like the "Ansari X Prize,"[42] the "Lunar Lander Challenge (LLC),"[43] and the "V-

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ing before any metal was cut. These rocket-plane projects were also lavishly funded and enjoyed top national priority. *See* Bell, *supra* note 29.

[39] Applying the 1.75% loss ratio for government-funded experimental rocket-planes, discussed *supra*, to Virgin Galactic's projected rate of 84 flights carrying 500 customers per year—including the first 42 flights carrying the 250 passengers who currently have firm reservations—Virgin can expect at least one fatal accident in its first year of operation.

[40] *See* Bell, *supra* note 29.

[41] The classical New Space industry response is that FAA certification imposes a costly burden upon the industry, and stifles its ability to create innovative designs. *See* the discussion in *Regulatory Shortcomings*, *infra* p. 134.

[42] The Ansari X PRIZE was modeled after the Orteig Prize, won by Charles Lindbergh in 1927, for being the first to fly non-stop from New York to Paris, and mirrors the hundreds of aviation incentive prizes offered early in the 20th Century that helped create today's $300 billion commercial aviation industry. On October 4, 2004, the X PRIZE Foundation awarded the $10 million Ansari X PRIZE to Mojave Aerospace Ven-

Prize,"[44]—as the X Prize Foundation, National Aeronautics and Space Administration (NASA), and the V Prize Foundation (in cooperation with the State of Virginia legislature) have done, respectively—is not going to close the gap. In the absence of a requirement to meet FAA flightworthiness standards,[45] prizes like these only encourage New Space entrepreneurs to "innovate" by marrying old concepts with existing (or unproven) technologies in their respective attempts to achieve suborbital space flight at minimal cost (as opposed to "cost effectively and reliably"). Obviously, something more is needed to enable the New Space CST market.

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tures for the flight of *SpaceShipOne*. To win the prize, famed aerospace designer Burt Rutan and financier Paul Allen led the first private team to build and launch a spacecraft capable of carrying three people to 100 kilometers above the earth's surface, twice within two weeks. *See* X Prize Foundation, *Ansari X Prize* (2008), *available at* http://space.xprize.org/ansari-x-prize.

[43] The LLC is designed to help industry develop the operational capacity to launch quick turnaround vertical take-off, vertical landing vehicles, which will be of significant use to many facets of NASA's commercial launch procurement market. The competition is divided into two levels. Level 1 requires a rocket to take off from a designated launch area, rocket up to 150 feet (50 meters) altitude, and then hover for 90 seconds while landing precisely on a landing pad 100 meters away. The flight must then be repeated in reverse—and both flights, along with all of the necessary preparation for each, must take place within a two and a half hour period. The more difficult course, Level 2, requires the rocket to hover for twice as long before landing precisely on a simulated lunar surface, packed with craters and boulders to mimic actual lunar terrain. The hover times are calculated so that the Level 2 mission closely simulates the power needed to perform the real lunar mission. *See* X Prize Foundation, *Northrop Grumman Lunar Lander Challenge 2007* (2008), *available at* http://space.xprize.org/lunar-lander-challenge/.

[44] The purpose of the V-Prize is to challenge members of the commercial space community to accomplish a feat reminiscent of Charles Lindbergh's record breaking non-stop flight from New York to Paris, France, in 1927. Spaceflight companies will compete to become the first in history to create a vehicle capable of launching from Virginia and landing in Europe in approximately one hour. The V-Prize Foundation hopes to provide the necessary catalyst for innovation, spawning breakthroughs in point-to-point suborbital spaceflight and the aerospace industry. The detailed rules and prize amount for the challenge were to be released in late 2008. The State of Virginia is supporting this challenge through the *Spaceflight Liability and Immunity Act,* Va. Code Ann. §§ 8.01-227.8-10, recently passed by the Virginia state legislature. Unless the *Act* is extended, it will expire on July 1, 2013. *See* Paul de Brem, *The V-Prize: One Hour to Europe*, THE SPACE REV. (Aug. 27, 2007), *available at* http://www.thespacereview.com/article/940/1.

[45] There is a direct correlation between flight system technology readiness levels (TRL), and the capability of flight systems to meet minimum flightworthiness standards.

The Commercial Space Transportation Study (CSTS) Alliance arrived at the same conclusion in 1994 when it found that the development of a completely commercial space transportation system, without government aid and incentives, was economically infeasible.[46] The study had the objective of examining individual market segments and how they might expand if lower prices were charged to customers.[47] The Alliance concluded:

> The investment cost for a new space launch system must be kept in the range of a few billion dollars. This indicates a potential paradox in the commercial space transportation market. High flight rates appear to be necessary to reduce the price per flight. However, reduced prices per flight reduce the revenue per flight, and consequently the cash flow available for investment payback. We have not been able to prove the commercial space market elastic enough to enable revenues per flight to be greater than the combined payback and operations costs per flight for a completely commercial developed system.[48]

It should be noted, however, that the investment cost for a new launch system (for either space tourism or point-to-point space transportation applications) includes not only the investment which closes the business case, but the technology investment required to build a safe, reliable space launch system. In other words, the revenues from each flight, based upon the payload capability (e.g., passengers, cargo, etc.) and the price per flight, must be balanced against the:

- Recurring cost charged to that flight;
- Repayment of the investment debt incurred to construct the system;

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[46] The CSTS Alliance comprised six aerospace companies in partnership with NASA's Langley Research Center, and looked at the markets for future commercial space launch vehicles. The markets examined included communication satellites, science missions, fast package delivery, and space tourism. *See* NASA, *Commercial Space Transportation Study* (Jan. 4, 1997), *available at* http://www.hq.nasa.gov/webaccess/CommSpaceTrans/.

[47] *Id.*

[48] *Id.*

- Repayment of the investment debt incurred to develop the requisite enabling and sustaining technologies required to meet safety and reliability standards;
- Some amount of return to the commercial investors; and,
- Net profits for reinvestment in the business.[49]

Figure 1, *infra*, illustrates the technology investment gap between the market's investment requirements and the New Space industry's investment requirement. The only way to close this gap, from a purely commercial standpoint, is to grow the market, reduce the investment, or reduce the industry's desired rate of return.[50]

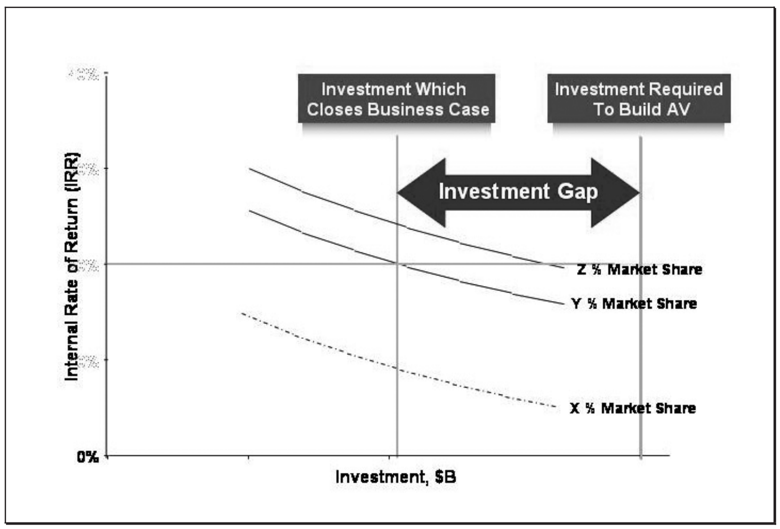

Figure 1: Technology investment gap illustrates market demand to close business case.[51]

Figure 2, *infra*, also shows the size of this technology gap, which was estimated by the Boeing Company to be approxi-

[49] *Id*.
[50] Stephens, *supra* note 13.
[51] *Id*.

mately $20 billion in 1999.[52] The $20 billion technology development cost represents the price for achieving aircraft-like reliability and safety in passenger-carrying aerospace vehicles.

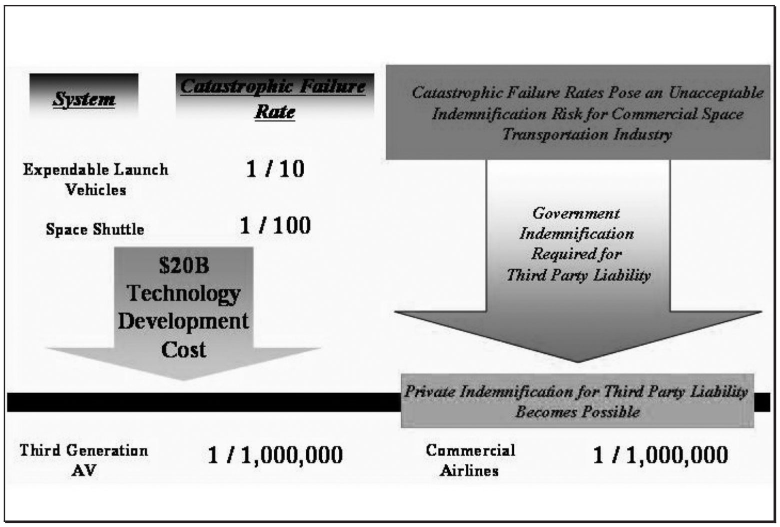

Figure 2: Evolving CST indemnification toward the airline paradigm.[53]

Since the New Space CST industry is unlikely to accept below-market returns; and closing the technology investment gap is desperately needed to ensure spacecraft reliability and safety—and thus, market growth—perhaps it is time to reconsider the government's role, vis-à-vis the industry, in reducing risk and growing the New Space market. Closing the technology investment gap, however, is only one step toward creating a solid foundation for the fledgling New Space Industry.

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[52] *Id.*

[53] *Id.* Launch insurance rates for commercial aerospace vehicles will largely depend on the reliability, replacement cost, and projected income of the vehicle. Based on the fact that today's suborbital space tourism vehicles do not meet aircraft flightworthiness standards, asset (or hull) insurance is going to be a major issue—not to mention second party liability insurance resulting from passenger-carrying flights.

Regulatory Shortcomings

The "suborbital adventure travel"[54] industry, or "space tourism" industry as it is popularly known within New Space circles, favorably compares itself to the aviation barnstormers who preceded the modern-day air transportation industry. Although it is true that both activities involve high-risk undertakings by individuals flying aboard questionably reliable vehicles, the comparison does not stop there. Barnstorming was not a precursor to point-to-point air transportation, as New Space promoters advocate, because the activity did not technically contribute to the development of air transportation. Similarly, space tourism will provide limited technical contributions to point-to-point space transportation because adventure human space flight is, like barnstorming, all about the "thrill of the flight"—not providing safe, reliable transportation.[55] In other words, people aren't using suborbital passenger space flight to get from "somewhere to somewhere," so it is not considered to be "transportation," per se. And, thanks to H.R. 5382, the Commercial Space Launch Amendments Act of 2004 (hereinafter "2004 Space Act"),[56] suborbital passenger-carrying spacecraft will "operate in the kind of regulatory vacuum that existed in the barnstorming era of aviation."[57] Adventure human space flight, for

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[54] Also called adventure human space flight (HSF), or personal HSF, or private HSF.

[55] Ordinary aircraft complete thousands of test flight hours before the FAA certifies them as safe for carrying crew or passengers. *See* Bell, *supra* note 29. When the House Transportation Committee's aviation subcommittee on commercial space transportation held its hearing on February 9, 2005, shortly after the 2004 Space Act became law, Representative James Oberstar (D-MN) criticized both the law and the FAA for adopting a "tombstone mentality" to passenger safety by doing nothing until the event of an accident. Oberstar also stated: "We need, at the least, a framework for safety in commercial space travel." Marion Blakey, the FAA Administrator at the time, responded: "[Suborbital passenger spaceflight] is not transportation, and I think it is a mistake to make analogies to transportation . . . people aren't using it to get from here to there . . . this isn't routine." *See* Jeff Foust, *The safety dance*, THE SPACE REV. (Feb. 21, 2005), *available at* http://www.thespacereview.com/article/326/1.

[56] Commercial Space Launch Amendments Act of 2004, H.R. 5382, 108th Cong. (2d Sess. 2004) [hereinafter 2004 Space Act].

[57] Indeed, New Space lobbyists and the U.S. Congress have chosen to ignore the large numbers of people killed during that era, as well as the numerous airlines that failed financially or were taken over by governments. *See* Bell, *supra* note 29.

the time being at least, is to be the "preserve of visionaries and daredevils and adventurers."[58]

Indeed, the suborbital adventure travel industry will be "well-served" by the present-day space transportation regulatory regime. This is because the 2004 Space Act codifies the right of "space flight participants," or passengers, to assume their own "informed" safety risk.[59] Rather than focusing on passenger safety, the FAA's safety regime is limited, fundamentally, to protecting the safety of the general or uninformed public on a "risk basis."[60] This heretical safety regime can be aptly summarized as follows:

> A licensee . . . must . . . inform a space flight participant [(SFP)], in writing, about the risks of launch and reentry, including the safety record of the vehicle type used in conducting the launch or reentry,[61] and must also inform space flight participants, in writing, that the vehicle is not government-certified as safe for carriage of persons. The latter requirement appears to dispel or defeat any expectation on the part of a space flight participant that the FAA has prescribed through regulatory requirements a level of safety comparable to that existing in aviation (or in other forms of common carriage).[62]

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[58] Representative Sherwood Boehlert (R-NY), commenting on the passage of the 2004 Space Act. *See* Sam Dinkin, *Getting into the Act*, THE SPACE REV. (Dec. 13, 2004), *available at* http://www.thespacereview.com/article/287/1.

[59] Timothy R. Hughes & Esta Rosenberg, *Space Travel Law (and Politics): The Evolution of the Commercial Space Launch Amendments Act of 2004,* 31 J. SPACE L. 1, 51 (2005).

[60] "Safety of the general or uninformed public" includes the public health and safety, safety of property, and national security and foreign policy interests of the United States. *See* 14 C.F.R. § 413.3 (2007). The FAA, Office of Commercial Space Transportation (AST), will currently license suborbital passenger-carrying spacecraft launch and reentry *operations* (not the spacecraft itself) based on specific regulations, licensing requirements, and review procedures that examine four areas of concern: site location safety (for both launch and reentry); operating procedures adequacy; personnel qualifications; and equipment adequacy. Taken together, these safety requirements are meant to limit public safety risk exposure to the level deemed acceptable at federal launch ranges for expendable launch vehicle launches. The safety requirements also take into account the hazards of operating suborbital passenger-carrying spacecraft over populated areas. *See* 14 C.F.R. §§ 431, 435 (2000).

[61] *See* Bell, *supra* note 29.

[62] *See* Hughes & Rosenberg, *supra* note 59, at 52. However, the 2004 Space Act also provides for the creation of SFP-protective regulations that are linked to certain circum-

In essence, suborbital adventure travel is analogous to organized extreme sports, like BASE jumping: where participants sign a series of waivers (including informed consent and exculpatory agreements); pack their own parachutes, or obtain one from a vendor (i.e., no standard equipment requirement); and pose no risk to public safety or property.[63]

"Common carriage" invokes specific duties, requiring a common carrier to act with the utmost care, skill, and diligence to protect the safety of passengers as may be mandated by the type of transportation provided, and the risk of danger inherent in it. By this legal standard, space tourism providers should be operating suborbital passenger-carrying spacecraft that are "flight-proven" systems, at a technology readiness level (TRL)[64] of 9 (see Figure 3, *infra*). Instead, because providers are not holding themselves out to be common carriers, their vehicles are operating at "technology demonstration" levels commensurate with TRL's 6–7, at best. In the words of Representative James Oberstar (D-MN), space tourism operators are literally "[experimenting] with human lives[—something] we don't allow . . . in the laboratories of the Food and Drug Administration or the National Cancer Institute[;] why should we allow it with space travel?"[65]

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stances. Specifically, any new regulations are limited to restricting or prohibiting design features or operating practices that: (1) result in a serious or fatal injury to crew or SFP's during a licensed or permitted commercial human space flight; (2) contributed to an unplanned event or series of events during a licensed or permitted commercial human space flight that posed a high risk of causing a serious or fatal injury to crew or SFP's; and (3) can be justified by the resulting or contributing events described, *supra*. The Act further directs that after December 23, 2012, any SFP-protective regulations shall take into consideration the evolving standards of safety in the commercial space flight industry. *See* 49 U.S.C. § 70105(c) (2004).

[63] "BASE jumping" is an acronym that stands for parachute free falls from buildings, antennae, spans or earth. *See* Eli Saslow, *A Heightened Chance of Death,* WASH. POST, Nov. 4, 2007, at A1.

[64] TRL's, used by NASA, are a systematic metric/measurement system that supports assessments of the maturity of a particular technology and the consistent comparison of maturity between different types of technology. *See* John C. Mankins, *Research & Development Degree of Difficulty (R&D3)* (Mar. 10, 1998), *available at* http://www.hq.nasa.gov/office/codeq/trl/r&d3.pdf.

[65] Foust, *supra* note 55.

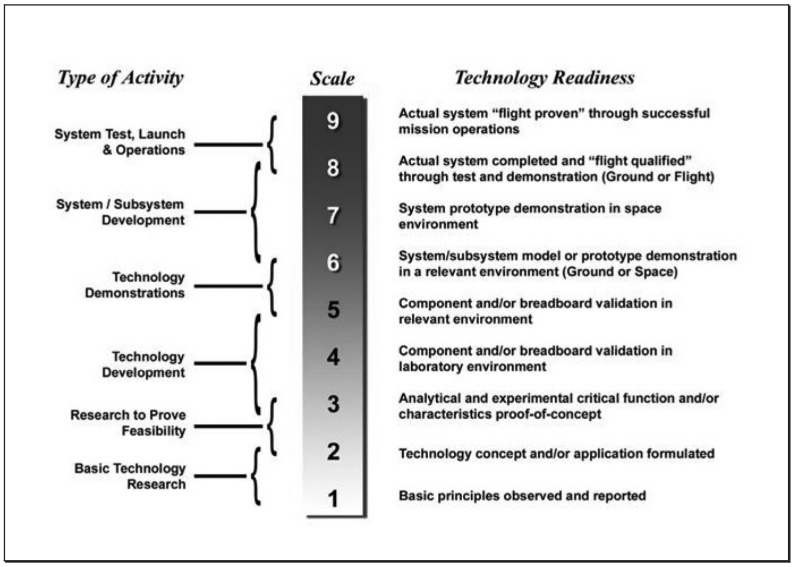

Figure 3: AV's and technology readiness levels.[66]

According to New Space promoters, "suborbital tourism is only the beginning for the [commercial space transportation] industry: nearly everyone is looking ahead to orbital flights, carrying passengers to destinations like Bigelow Aerospace's proposed orbital facility."[67] But, if suborbital space tourism is not considered to be transportation, and therefore not subject to—like the aviation barnstormers of old—the duties of common carriage; how can the space tourism industry possibly bridge the technology gap required for common carriage when there are no incentives to do so?[68]

[66] John C. Mankins, *Technology Readiness Levels* (Apr. 6, 1995), *available at* http://www.hq.nasa.gov/office/codeq/trl/trl.pdf.

[67] Foust, *supra* note 55.

[68] New Space suborbital tourism "hopefuls," like XCOR Aerospace, have often stated that if their suborbital vehicles are not safe, they will be out of business. Yet, companies like XCOR are the first to publicly decry any attempt by the government to develop flightworthiness standards for their vehicles. How can XCOR state that its suborbital vehicle is "safe enough" to carry passengers when it doesn't meet a single flightworthiness standard?

Needed: An Alternative Strategy

Aircraft meet flightworthiness standards that promote safety and reliability in aircraft systems and apply to all aircraft designs, whether they are operational or developmental. The emergence of commercial aerospace vehicles, in contrast, will not have the benefit of aircraft-like flightworthiness standards. Decades ago aircraft manufacturers, through NACA-sponsored R&D projects and a compulsory technology transfer agreement, created the essential market-enabling technologies needed for commercial aircraft development.

Unfortunately, the NACA paradigm is not available for today's New Space CST industry because it has been superseded by the Government/Large-Aerospace-Firm boycott (hereinafter "LAF-boycott"). As members of this boycott, the four largest U.S. aerospace firms[69] receive billions of dollars from the Federal Government, without risk to investors, for developing government-sponsored launch vehicles—not commercially viable technologies for aerospace vehicles. Furthermore, these firms have de facto exclusive rights to the technologies and know-how they develop. As a result, New Space efforts to raise capital on the open market for their innovative aerospace vehicle concepts are stymied. Consequently, space tourism suborbital vehicle operators have resorted to a vehicle development strategy that largely ignores the human space flight and aviation legacies that preceded the advent of space tourism.[70] Needless to say, an alternative strategy is needed, because commercialism[71] is critical for the success of the commercial space transportation industry. If space tourism is introduced prematurely as "fully operational,"

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[69] The Boeing Company; as well as the Lockheed-Martin, Northrop-Grumman, and Orbital Sciences Corporations.

[70] This is because New Space CST companies believe that government-derived expendable launch vehicle, X-vehicle, and *Space Shuttle* experience do not directly translate into useful paradigms for developing, operating or regulating commercial human spaceflight. Another perception among these companies is that NASA's flight safety requirements for human space flight would levy unbearable, costly burdens upon the industry. Regardless of these perceptions, however, NASA has accumulated a wealth of technologies and know-how that should not be summarily dismissed as irrelevant to commercial human space flight.

[71] Commercialism, here, is the practices, methods, aims, and spirit of commerce or business. WEBSTER'S NEW RIVERSIDE UNIVERSITY DICTIONARY 286 (2d ed. 1988).

it runs the risk of being vilified by the lawsuits, politics, and public relations failures that are sure to follow when the first fatal accident occurs. Space tourism, in essence, should not be allowed to proliferate before it is safe.

This thesis continues in Section I. BACKGROUND with overviews of two post-NACA, post *Space Shuttle* development, reusable launch vehicle (RLV) technology development programs. These two programs were, fundamentally, attempts to realize "cost effective designs for cheap, reusable space transportation." There are many parallels between the NASA RLV technology development experience, and the challenges the New Space CST vehicle developers face (whether perceived and understood by the industry or not). Hence, a review of these programs will provide some insight into how much thought and innovation went into NASA's RLV technologies, despite severe political and budget pressures.

Section II. DISCUSSION then focuses on the IP doctrines and economics of the aviation-based NACA paradigm, their revolutionary success, and how they can be applied to the nascent, commercial space transportation industry (assuming, of course, that the New Space entrepreneurs are capable of working together). Although special emphasis will be placed on the first three elements of the alternative strategy outlined, *infra* (see Section II.C.3. *Collective Development Strategy*), these elements will be developed within the context of the over-all five-point strategy.

I. BACKGROUND

Although the *Space Shuttle*, a first-generation reusable launch vehicle system, was originally conceived by NASA as a cost-effective design for cheap, reusable space transportation, the enabling technologies that made the *Shuttle* possible fundamentally combined the performance of expendable launch vehicles with reusability. Unfortunately, the *Space Shuttle* development program was compromised from the outset by political and economic decisions. As a result, the *Shuttle* program endured innumerable economic assaults from the Office of Management and Budget (OMB) that ended when NASA proved that no economies of scale could be realized by reducing the payload bay size or any other major component of the *Shuttle Orbiter* system.[72] In essence, NASA had been given no other choice but to adopt a partially expendable booster system using a "design-to-cost" paradigm. Hence, a brief review of NASA's successive attempts to create post-*Shuttle*, fully reusable launch vehicle systems and enabling technologies may provide a glimpse of what the future holds for New Space CST spacecraft developers.

A. Enabling the Shuttle's Successor: X-33

The National Aeronautics and Space Administration has always had a goal, it seems, of providing low cost, reliable access to space. This goal received a major impetus in 1993 when, in response to Congressional direction, NASA conducted its *Access to Space* study. The study, published in January 1994, examined three potential alternatives:

1. Provide necessary upgrades to continue primary reliance on the Space Shuttle and the current expendable launch vehicle (ELV) fleet through 2030.

2. Develop a new expendable launch system utilizing today's state-of-the-art technology, and transition from the Space Shuttle and today's expendable launch vehicles starting in 2005.

3. Develop a new reusable advanced technology next-generation launch system, and transition from the Space Shuttle and today's expendable launch vehicles starting in 2008.[73]

NASA's study concluded "that the most beneficial option is to develop and deploy a fully reusable single-stage-to-orbit (SSTO) pure rocket launch vehicle fleet incorporating advanced technologies, and to phase out current systems beginning in the

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[72] Richard P. Hallion & James O. Young, *Space Shuttle: Fulfillment of a Dream, in* 2 THE HYPERSONIC REVOLUTION, FROM SCRAMJET TO THE NATIONAL AEROSPACE PLANE (1964-1986) 1114 (Richard P. Hallion ed., 1987).

[73] NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, ACCESS TO SPACE STUDY, SUMMARY REPORT 3 (1994).

2008 time period."[74] The study also determined "that while the goal of achieving single-stage-to-orbit fully reusable launch vehicles has existed for a long time, recent advances in technology make such a vehicle feasible and practical in the near term provided that necessary technologies are matured and demonstrated prior to start of vehicle development."[75] Furthermore, the study found that prior to the full-scale development of a fully reusable launch vehicle program;[76] all technologies must be matured to a technology readiness level (TRL) of at least "6."[77]

Although the *Access to Space* study identified both enabling (requisite) and enhancing (upgrading) technologies common to three representative RLV design options,[78] a number of those technologies were not at the required maturity levels. Specifically:

1. Graphite-composite reusable primary structures;

2. Aluminum-lithium and graphite-composite reusable cryogenic propellant tanks;

3. Advanced main propulsion systems designed for robustness and operability;[79]

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[74] *Id.* at i.

[75] *Id.* at ii.

[76] The fully reusable launch vehicle program was to comprise four phases: predevelopment (consisting of rigorous preliminary design efforts to fully derive requirements and to select critical technologies, implementation of required flight and ground test experiments, and a technology maturation program); full-scale development (including final design and development coupled with a prototype test program); production; and operations. The basic philosophy of the first two phases was to lower program risk by maturing technologies before full-scale development, to verify the integration of the entire system, and to fully define the operating envelope before the vehicle became operational. *Id.* at 53.

[77] *Id.* at 56. *See also* Figure 3, *supra* p. 138, where TRL 6 is defined as: "successful system/subsystem model or prototype demonstration in a relevant environment (ground or space)."

[78] *Id.* at 54. The three representative RLV design options investigated included: vertical takeoff, horizontal landing (VTHL) wing body; vertical takeoff, horizontal landing (VTHL) lifting body; and vertical takeoff, vertical landing (VTVL) concepts. *See* STEPHEN A. COOK, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, THE REUSABLE LAUNCH VEHICLE TECHNOLOGY PROGRAM AND THE X-33 ADVANCED TECHNOLOGY DEMONSTRATOR 7 (1995).

[79] Key targets for the next-generation propulsion system were robustness, operability, high thrust-to-weight ratio, high specific impulse, and an affordable development program with acceptable risk. The *Shuttle* SSME "off-the-shelf" engine adequately ful-

4. Low-maintenance thermal protection systems; and,
5. Advanced avionics that include vehicle health monitoring and autonomous flight control.[80]

Advanced technologies that contributed to reducing RLV dry weight were also considered critical, because vehicle dry weight is a major performance driver—and thus cost driver.[81]

NASA elected to implement the *Access to Space* technology development and demonstration plan on July 2, 1996; when it awarded a Phase II contract for the *X-33 Reusable Launch Vehicle Program*[82] to Lockheed Martin Skunk Works.[83] In fact, NASA and Lockheed Martin conducted the *X-33 Program* under a "cooperative agreement—a financial instrument with which a government entity and one or more public or private organizations jointly fund and implement an activity to achieve common objectives."[84] One of the key elements of this Phase II program was to design, develop, fabricate, and flight test the *X-33* flight demonstrator, an experimental, subscale flight vehicle.[85] Other key elements of the *X-33 Program* included an extensive ground-based program to provide the required additional technology development, and conceptual through preliminary design of an operational RLV.[86] Hence, the purpose of the *X-33* advanced technology demonstration program was to not only prove the concept of SSTO reusable launch vehicles; but also provide significant technical risk reduction for government and private sector decisions regarding the development of a full-scale com-

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filled only two of the targets: thrust-to-weight ratio, and specific impulse. *See* COOK, *supra* note 78, at 2.

[80] R.W. Powell et al., *The Road from the NASA Access-to-Space Study to a Reusable Launch Vehicle, in* IAF 49TH INTERNATIONAL ASTRONAUTICAL CONGRESS (Melbourne, Australia Sept. 28, 1998).

[81] *Id.*

[82] Hereinafter "X-33 Program."

[83] *See* Powell, *supra* note 80.

[84] Lockheed Martin had made agreements with Allied-Signal Aerospace, B.F. Goodrich Aerospace, Boeing-Rocketdyne Division, and Sverdrup Corporation to assist in the X-33 Program. GOVERNMENT ACCOUNTING OFFICE, SPACE TRANSPORTATION: STATUS OF THE X-33 REUSABLE LAUNCH VEHICLE PROGRAM 1 (1999) [hereinafter STATUS OF THE X-33].

[85] *See* Powell, *supra* note 80.

[86] *Id.*

mercial operational RLV system prior to the end of the millennium.[87]

Unfortunately, the *X-33 Program* ended on March 31, 2001, when the cooperative agreement between NASA and Lockheed Martin expired.[88] Although NASA could have chosen to build a *Space Shuttle* replacement by developing proven technologies, it decided instead to take the high risk, high pay-off road to creating an entirely new vehicle.[89] Among the many technology development challenges Lockheed Martin faced, four proved to be insurmountable—given NASA-levied cost and time constraints. These challenges included the development of:

1. A wingless "lifting body" airframe that could keep the vehicle flying smoothly during both its launch and reentry phases of flight;

2. Internal composite liquid hydrogen fuel tanks that could withstand the stresses of a space launch while filled with pressurized liquid hydrogen at a temperature of 423 degrees below zero, Fahrenheit;

3. Linear aerospike rocket engines, which had never been flown before; and,

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[87] Specifically, the *X-33* was a half-scale model of Lockheed Martin's planned single-stage-to-orbit *Venture Star* RLV, a commercial, operational vehicle that would be based on and developed after the *X-33*. Lockheed Martin and NASA were to base the decision to proceed with developing the *Venture Star*, in part, on the results of the *X-33* Program. See STATUS OF THE X-33, *supra* note 84, at 1.

[88] NASA announced, on March 1, 2001, that it would not add Space Launch Initiative funds to the *X-33 Program*; and that as a result, the current *X-33 Program* would "come to completion" when the cooperative agreement expired—unless Lockheed Martin chose to go forward with the program with its own funds. *See* Press Release, National Aeronautics and Space Administration, NASA Reaches Milestone in Space Launch Initiative Program; Also Announces No SLI Funding for X-33 or X-34 (Mar. 1, 2001), *available at* http://www.nasa.gov/home/hqnews/2001/01-031.txt [hereinafter NASA Press Release]. Lockheed Martin responded to NASA's announcement by stating "the business case [doesn't] support continued development without government assistance." *See* SPACE and TECH, *Lockheed Martin Will Not Continue X-33/VentureStar Development* (Mar. 5, 2001), *available at* http://www.spaceandtech.com/digest/sd2001-09/sd2001-09-004.shtml.

[89] *NASA's billion-dollar shuttle replacement may never fly,* CNN, Sep. 25, 2000, *available at* http://archives.cnn.com/2000/TECH/space/09/25/troubledspaceship.ap/index.html.

4. A Metallic thermal protection system.[90]

Art Stephenson, Director of NASA's Marshall Space Flight Center, stated that NASA's decision to end *X-33 Program* funding had been "a very tough one," but the right business decision. As Mr. Stephenson explained in a NASA press release:

> "We have gained a tremendous amount of knowledge from these X-programs, but one of the things we have learned is that our technology has not yet advanced to the point that we can successfully develop a new reusable launch vehicle that substantially improves safety, reliability and affordability . . . [the] Space Launch Initiative [(SLI)] will take us to that point . . . ."[91]

B. Enabling the Next Generation: SLI

The *X-33 Program* segued into the Space Launch Initiative, also known as the Second Generation RLV Program, in February 2001.[92] Originally conceived as a $4.8 billion, six-year effort, this program incorporated three strategic goals:[93]

1. Investing in technology development and other activities needed to enable a new space transportation system that would be safer, more reliable, and less expensive than the Space Shuttle;[94]

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[90] *Id. See also* STATUS OF THE X-33, *supra* note 84, at 7.

[91] *See* NASA Press Release, *supra* note 88.

[92] THOR HOGAN & VIC VILLHARD, NATIONAL SPACE TRANSPORTATION POLICY, ISSUES FOR THE FUTURE 21 (RAND Science and Technology, Working Paper No. WR-105-OSTP, 2004).

[93] *Id.*

[94] In the first two years, a range of risk reduction activities and milestone reviews were to gradually narrow viable reusable space transportation systems to two or three candidates. The purpose of this groundwork was to drive a decision for full-scale development of one system by 2006 and operations by early next decade. *See* Fact Sheet, NASA Marshall Space Flight Center, The Space Launch Initiative, Technology to pioneer the space frontier (Apr. 2002), *available at* http://www.nasa.gov/centers/marshall/news/background/facts/slifactstext02.html [hereinafter The Space Launch Initiative].

2. Implementing a coordinated approach to develop flexible, commercially produced, reusable launch vehicles;[95] and,

3. Purchasing cargo resupply services for the International Space Station—using commercial launch vehicles—to serve as a back-up for the Space Shuttle and Russian Progress rocket.[96]

Within the purview of these goals, the SLI program was focused on reducing business and technical risks so that private industry could be confident of turning a profit with a new RLV system.[97] Risk reduction activities were to include: business development and planning; technology research in eight different areas (as outlined in Table 1, *infra*); advanced development activities; and flight and ground experiments.[98]

Successful implementation of the SLI program would have led to a fully operational, second generation RLV system by 2010, capable of placing one pound of payload into orbit for $1,000.[99] The plan was then to follow through with the development of a third generation aerospace vehicle that would further reduce launch costs by a factor of ten, or $100 per pound, by 2025[100] (see Figure 4, *infra*). It was anticipated that launch efficiencies of this magnitude would enable the development of a robust commercial space transportation market, with the "added bonus of offsetting government expenditures for space launch."[101]

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[95] The purpose of this approach was to ensure that NASA-unique hardware developed by and for NASA-unique missions—such as crew transport and planetary exploration—is compatible with commercial capabilities. *Id*.

[96] *Id*.

[97] *Id*.

[98] *See* The Space Launch Initiative, *supra* note 94.

[99] HOGAN & VILLHARD, *supra* note 92, at 22.

[100] *Id*.

[101] *Id*.

TECHNOLOGY	OVERVIEW
Airframe Systems	Focus on advanced airframe design and integration methods to improve reliability and reduce design cycle time; robust, low-cost, low maintenance structures, tanks, thermal protection systems and thermal structures; and aerothermodynamic assessments which yield higher-fidelity information early in the design process.
Flight Demonstrations	Focus on flight-testing of selected hardware and software technologies (avionics, guidance and navigation systems, thermal protection systems, fuel tanks, integrated vehicle health management systems, autonomous flight operations and crew escape systems) in a relevant ascent, orbit, and reentry environment to reduce the risk of future launch system development.
Flight Mechanics	Focus on development of adaptive software that will allow spacecraft (rather than the pilots) to solve problems, and advances in automatic rendezvous and docking systems.
Integrated Vehicle Health Management	Focus on highly integrated systems that could include advanced sensors, model-based reasoning systems, diagnostic and prognostic software, and intelligent software managers and planners. These technologies will be used to collect, process, and integrate information about the vehicle's health, enabling informed decision-making and logistics management.
NASA-Unique Systems	Focus on a wide variety of technologies including crew escape systems, environmental control systems, cockpit systems, mission planning, flight operations, crew return vehicles, crew transfer vehicles, and non-crew transfer vehicles.
Operations	Focus on advanced check-out & control systems, separation systems, ground to flight interfaces, propellant densification, and fluid transfer technologies.
Propulsion	Focus on specific Earth-to-orbit technologies including rocket, augmented rocket, and combined-cycle propulsion (which may include air or magnetic launch assistance).
Vehicle Subsystems	Focus on advanced technologies in actuators, power, and avionics.

Table 1: SLI technology research areas.[102]

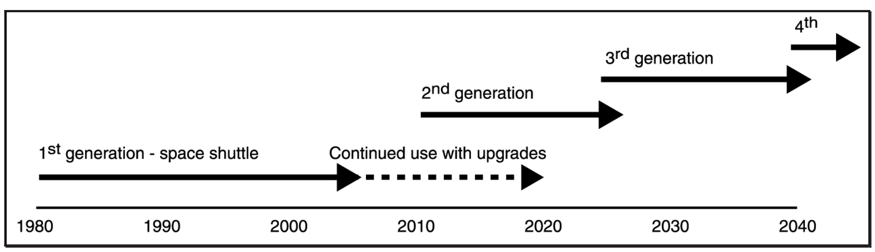

Figure 4: Illustration of NASA's overall space transportation plans.[103]

Alas, unlike the *X-33 Program*, SLI began "fading into the sunset" when NASA failed to address several major problems facing the program before November 2002, when a planned Systems Requirements Review (SRR)[104] was scheduled to occur.[105]

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102 *Id*.

103 GOVERNMENT ACCOUNTING OFFICE, SPACE TRANSPORTATION, CHALLENGES FACING NASA'S SPACE LAUNCH INITIATIVE 5 (2002) *available at*, http://www.gao.gov/new.items/d021020.pdf [hereinafter CHALLENGES].

104 The purpose of the SRR was to focus attention on fewer space transportation architectures and technology areas, select three architectures that could be pursued, and reach agreement on the development of system requirements. *See* CHALLENGES, *supra* note 103, at 7.

The Government Accounting Office (GAO), in a report entitled *Space Transportation: Challenges Facing NASA's Space Launch Initiative*, summarized the beginning of the end for SLI as follows:

> [Prior to conducting an SRR], NASA has to complete a reassessment of its overall space transportation plans. In doing so, it must decide whether it should continue pursuing the development of second-generation vehicles as planned, pursue alternative ways to develop the second generation in order to more quickly replace the [Space Shuttle], or postpone these efforts altogether indefinitely until there is a major breakthrough in technology that could vastly improve performance and reduce costs. This decision will be difficult, given the uncertainties about the availability of technologies needed to reduce costs and enhance performance for future space flight.[106]

NASA's FY 2005 budget request quietly replaced the "Aerospace Technology Enterprise," under which SLI activities were budgeted in the FY 2004 request,[107] with the "Exploration Systems Enterprise;" to pursue the new "Transportation Systems (TS) Theme." Needless to say, the TS Theme included transition and closeout activities for the Orbital Space Plane and Next Generation Launch Technology programs—the last vestige of SLI.[108]

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[105] HOGAN & VILLHARD, *supra* note 92, at 22.

[106] *See* CHALLENGES, *supra* note 103, at 2.

[107] *See* Fact Sheet, National Aeronautics and Space Administration, Summary of FY 2004 Budget Request 16 (Feb. 3, 2003), *available at* http://www.nasa.gov/pdf/1995main_2004_Budget_Highlights.pdf.

[108] *See* Fact Sheet, National Aeronautics and Space Administration, Summary of FY 2005 Budget Request 1-25 (Jan. 14, 2004), *available at* http://www.nasa.gov/pdf/55524main_FY05%20Agency%20Summary-2.31.pdf. On Nov. 13, 2002, in response to a GAO report (*See* CHALLENGES, *supra* note 103, at 19), NASA revealed the results of its new Integrated Space Transportation Plan (ISTP). This new plan included two salient features: *Orbital Space Plane* (*OSP*), providing a crew transfer capability, as early as possible, to ensure access to and from the *International Space Station* (*ISS*); and Next Generation Launch Technology Program, funding developments in areas such as propulsion, structures, and operations for a next generation RLV. *See* HOGAN & VILLHARD, *supra* note 92, at 25.

C. Common Themes

In summary, a cost-effective design for cheap, reusable space transportation requires an examination of the technologies; technical expertise and experience; operational flight experience; and the financial resources available to begin such an endeavor and follow it through to completion. Based on this premise, there are fundamental, common themes underlying the failures of the *X-33* and SLI programs.

The first, and probably most important theme, "was the failure to subject [both programs] to cold, hard technical and economic analysis" before implementing them.[109] From the start, technical and economic optimism pervaded both programs; and skepticism concerning their viability was politically unacceptable.[110] At nadir, according to Dr. Henry Hertzfeld, three factors contributed to the demise of the *X-33*—and thus SLI—programs:

1. A mismatch in expectations and goals among different players; including government agencies, Congress, vehicle developers, and commercial launch customers;

2. Inadequate understanding of the commercial marketplace and market risks among government decision makers; and,

3. Overly optimistic technical and market goals.[111]

Substitute the words "New Space" for "government" in number "2," *supra*, and all three factors apply to the prospective space tourism operators of today.

A second pervasive theme is NASA's attempt, in both programs; to develop full-scale, second generation reusable vehicles designed to satisfy both commercial space transportation and government needs (see Figure 5, *infra*). NASA's desire to do this worked at cross-purposes to its stated goal of developing the requisite enabling technologies for such a vehicle. Rather,

[109] HENRY R. HERTZFELD ET AL., THE GEORGE WASHINGTON UNIVERSITY SPACE POLICY INSTITUTE, LAUNCH VEHICLES: AN ECONOMIC PERSPECTIVE 22 (2005).
[110] *Id.*
[111] *Id.*

NASA should have "stuck close to its knitting" and focused exclusively on its technology development mandate.

The third, and final theme, is a NASA contractor's proclivity to "cut corners" at the first sign of a budget or technical challenge, thus undermining the very foundation upon which a next generation reusable launch system depends. A classis example of this occurred on the *X-33 Program*. When the *X-33* subscale flight demonstrator incurred cost overruns resulting from weight-growth problems, the first area Lockheed Martin cut was the "ilities"—the operations technology disciplines of reliability, maintainability, supportability, and availability (RMS&A).[112] Well-developed RMS&A technologies are crucial to the operational viability of a reusable, commercial space launch system; yet, Lockheed Martin chose to ignore this in favor of a manpower-intensive paradigm (just like the *Space Shuttle* and *Apollo* programs). Once again, substitute "New Space" for "Lockheed Martin," and this theme applies to present-day prospective space tourism operators as well.

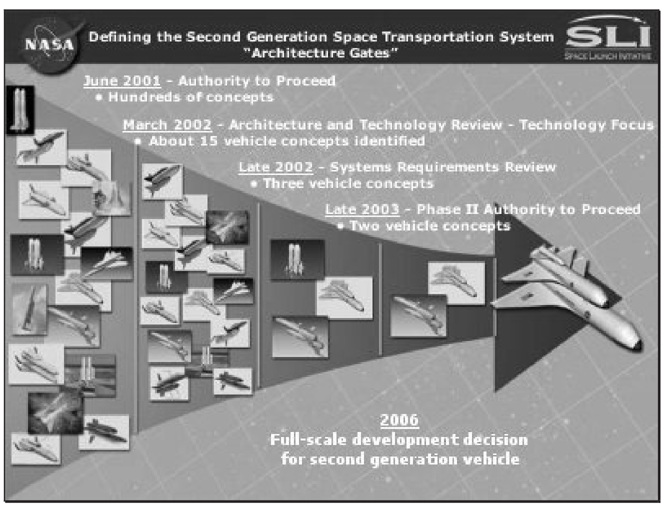

Figure 5: SLI second generation RLV system "architecture gates."[113]

[112] The author personally witnessed this event in 1997 while serving as the Allied-Signal Program Manager of the X-33 Operations Engineering Group, which included the RMS&A function.

[113] The Space Launch Initiative, *supra* note 94.

The consequences of "design to cost" were clearly manifested by the results of the final *Space Shuttle* design and operations concept, as well as in the execution of the *X-33* and SLI programs. Although the express goals of the latter two programs were to create the requisite, enabling technologies for the *Shuttle*'s fully reusable, second-generation successor; these programs instead followed a *Shuttle*-esque development path to oblivion. Indeed, there are many "lessons" embedded within the three "common themes"—discussed, *supra*—that could benefit the New Space industry. Assuming, however, that there truly is a market for passenger and cargo-carrying commercial space transportation services, the New Space entrepreneurs are going to require a better strategy than the "design-to-cost" one they have been pursuing thus far.[114] In the words of a former NASA RLV Technology Program manager:

> The space launch industry is at a crossroads much like the one faced by the fledgling airline industry in the early 1930's. An evolutionary technical leap, coupled with a revolutionary cultural shift, must be made—analogous to the DC-3 aircraft—for space launch to become truly routine.[115]

But the technologies that created the *DC-3* aircraft were conceived to serve a market for going "somewhere to somewhere," enabled by the NACA paradigm, and validated through the Kelly Act.

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[114] The New Space CST development strategy shuns vehicle design standards and promotes "minimum cost design" (MCD) methodologies for passenger-carrying vehicles. MCD follows a set of five design rules: small; simple; reusable; not necessarily maximum reliability or performance; and don't push "state-of-the-art"—use existing technology. *See* Jonathan D. Stevenson, *Cheap Access to Space (CATS) and Minimum Cost Design (MCD),* MIT Rocket Team Lecture Series, (Jan. 15, 2002) *available at* http:// web.mit.edu/cats/www/resources/Stevenson_talk.pdf.

[115] *See* COOK, *supra* note 78, at 1.

II. DISCUSSION

> *Access to space will never be routine until we learn how to take-off and land like gentlemen.*—General Donald J. Kutyna, USAF (ret.).[116]

Based on the development paradigm of today's space tourism suborbital vehicle companies, the focus of future New Space aerospace vehicle concepts will revolve around the technical performance, ease of manufacture and the minimal amount of testing and analysis required to validate a flight vehicle system as "safe."[117] The primary impetus for this focus will be the aerospace vehicle operator's need to drive launch costs down to less than $1,000 per payload pound to orbit, which in turn forces many design tradeoffs among a flight vehicle's subsystems, propulsion, structure and operability. However, design tradeoffs must not only take into account the "technical performance" issue of getting a specific payload mass into orbit; but also address the fact that "the concept of low-cost immediately imposes the requirements of high usage rates and fast turnaround times with minimum maintenance."

At the heart of an aerospace vehicle's technical performance is its dry mass fraction, which is the ratio of an aerospace vehicle's structural mass to its total mass (with a full propellant load and payload). Due to the inherent limitations of state-of-the art propulsion systems, any increase in an aerospace vehicle's dry mass fraction will directly reduce the payload mass it can deliver to orbit (thus affecting an aerospace vehicle venture's revenue per flight). In order for an aerospace vehicle to perform the same mission as an expendable launch vehicle, assure very high reliability and return to its spaceport for a quick turnaround, its dry mass must accommodate many additional

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[116] General Donald J. Kutyna, USAF (ret), *Titan IV Expendable Launch Vehicle Source Selection Proceedings,* Space Division, Air Force Systems Command, Los Angeles Air Force Station, California (1984).

[117] As previously discussed, *supra*, "safe"—to a New Space entrepreneur—means the "minimum cost design" necessary to "protect the public health and safety, safety of property, and national security and foreign policy interests of the United States" in accordance with the minimal, "risk-based" requirements (otherwise known as "performance standards") comprising 14 C.F.R. Part 400 (2007).

requirements. These requirements include, but are not limited to: retro/maneuvering engines; additional propellants and tanks; return maneuvering structures and mechanisms; reentry thermal protection systems; reusability modifications to structures, engines, tanks and avionics; health monitoring systems; safe return-from-abort equipment; and landing gear/supports.

Imposing the requirements of high usage rates and fast turnaround times with minimum maintenance on aerospace vehicles further exacerbates AV dry mass growth propensities. This is because enhanced factors-of-safety, and higher levels of redundancy must now be designed into an aerospace vehicle system to allow it to safely and reliably perform 100+ sorties between major overhauls.[118] Naturally, the only way to certify these criteria is through extensive flight testing. Unfortunately, the New Space entrepreneurs will not only be reticent to perform a rigorous flight test program (because of the high "cost burden"), but they will not possess the enabling and sustaining technologies necessary to ensure their vehicles' safe, reliable performance on a routine basis.[119] Furthermore, the FAA's current licensing regime for RLV operations will not ensure the functional integrity of New Space flight vehicles and subsystems.

Nevertheless, it is imperative to begin planning for the FAA certification of next-generation New Space aerospace vehicles well before these systems are built and tested.[120] First, such

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[118] One of the *X-33*'s life cycle goals was 100 flights between major overhauls. *See* Powell, *supra* note 80.

[119] *See* the discussion in *Regulatory Shortcomings*, *supra* p. 134.

[120] As previously discussed, *supra*, in air law, aircraft must meet airworthiness and vehicle certification requirements in accordance with national and international standards. These regulations are designed to promote safety and reliability in aircraft systems, and apply to all aircraft designs, whether they are operational or developmental. To enable operationally prevalent aerospace vehicles to achieve their maximum potential, they will also need to function within the confines of an international regulatory framework and an established airworthiness code. New Space suborbital passenger-carrying spacecraft should, in essence, be catalysts for the codification of AV-specific flightworthiness standards, and validating these unique certification requirements through revenue-generating, operational flight-testing. In fact, this concept was recently recognized in a European Space Agency (ESA) white paper which stated: ". . . the civil aviation regulatory authorities of the countries concerned and the competent agencies of the European Community should be at the forefront of . . . setting up . . . a regulatory framework for Space Tourism in Europe . . . aiming also at a more level playing field for

planning will initiate the process of removing a major source of uncertainty and risk from the marketing and financing end of developing these operationally pervasive vehicles. Secondly, it will enable the New Space industry to work alongside government regulators and speed the process of certification. Finally, it will allow the legal and regulatory process to interact holistically with the physical design and manufacturing process of the vehicle.[121] This, in turn, will influence the final design and operational characteristics of the system—directly affecting the indemnification rates and, ultimately, the business case for the New Space AV enterprise. More fundamental than aerospace vehicle certification, however, is the underlying development of AV-enabling and sustaining technologies that will provide the equivalent breakthroughs in operability that the NACA technology transfer program provided for the nascent commercial aviation industry in the early 1900's.

A. The NACA Paradigm

The primary goal of the NACA technology transfer program was to produce basic and applied research that would be useful to its military and industry aeronautical customers in the near-term.[122] The program was federally funded and executed, with a scientist/engineer and a committee of interested government agency members leading the strategic direction.[123] A problems-oriented, industry representative-dominated, sub-committee

all worldwide players, and supporting the interests of European industry." *See* European Space Agency, *ESA's position on privately-funded suborbital spaceflight* (Apr. 10, 2008) *available at* http://esamultimedia.esa.int/docs/gsp/Suborbital_Spaceflight_ESA_Position_Paper_14April08.pdf.

[121] SCOTT JACKSON, SYSTEMS ENGINEERING FOR COMMERCIAL AIRCRAFT 9 (Ashgate Publishing Company 1997).

[122] Congress established the NACA as a rider to the Naval Appropriations Act of 1915 "to supervise and direct the scientific study of the problems of flight, with a view to their practical solution." *See* NASA, *The First Century of Flight: NACA/NASA Contribution to Aeronautics* (2002), *available at* http://teacherlink.ed.usu.edu/tlnasa/pictures/poster/FirstCenturyofFlight.pdf [hereinafter *The First Century of Flight*].

[123] ALEX ROLAND, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, 1 MODEL RESEARCH: THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS, 1915–1958, 106 (1985).

forum selected specific research projects.[124] Since research was close to the aviation industry's interests, results found immediate application. Sub-committee membership, several information research notes publications, ample lab visit opportunities, and an annual industry conference aided in the knowledge transfer process.[125]

More importantly, however, NACA research was not mission-oriented, did not produce systems, and did not perform or lead any production efforts.[126] Research was typically "cut-and-try," involving systemic variation and engineering experimentation, and was broadly available via open publication and close contact with industry. The NACA program's key technical accomplishments included cooling and cowling of air-cooled engines, reduction of interference effects created by the junctures of wing and fuselage, and the development of standard sets of wing sections and a diesel engine for aircraft.[127] But the Committee's finest hour was the cross licensing agreement it worked out among the U.S. aircraft manufacturers to resolve key intellectual property issues, and avert a production shutdown on the eve of World War I.[128]

i. Aircraft Cross Licensing Agreement

The aircraft manufacturers agreement had its origins in the early days of flight. In 1903 the Wright Brothers patented a "wing warping" technique of lateral control in which the wings were actually twisted in opposite directions to create a differential lifting force.[129] Glenn Curtiss achieved this same result when he subsequently incorporated the concept of ailerons (wing flaps) in his successful flights in 1908.[130] By 1915, all airplanes used wing flaps instead of the Wright method.[131]

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124 *Id.*
125 *Id.* at 111.
126 *The First Century of Flight*, *supra* note 122.
127 *Id.*
128 ROLAND, *supra* note 123, at 37.
129 Bittlingmayer, *supra* note 7, at 22.
130 *Id.*
131 *Id.*

The Wrights sued Curtiss for patent infringement, and in a series of patent lawsuits the courts generally sided with the Wrights, agreeing that the Wrights' creation of a differential lifting force was a unique contribution to flying. But when the Wrights sold the rights to their pivotal patent for over $1 million in 1916, the acquiring company (Wright-Martin) notified the other aircraft manufacturers that they would have to pay a royalty of five per cent on each aircraft sold, with a minimum annual royalty of $10,000 per manufacturer.[132] Furthermore, Wright-Martin demanded this royalty on all aircraft, whether they achieved differential lifting by the wing-warping technique of the Wrights or by the far more popular ailerons employed by Curtiss—and the litigation continued.[133] But with the formal entry of the U.S. into World War I imminent, a solution to the patent litigation was sought because the threat of patent infringement lawsuits had already frightened many manufacturers out of the field.

Following the U.S. declaration of war in April of 1917, the National Advisory Committee for Aeronautics proposed a patent cross licensing agreement that was similar to one that was in effect in the automobile industry.[134] The new agreement provided a ceiling of $2 million on payments to Wright and Curtiss, and applied, by stipulation, to aircraft structures, although it excluded engines and instruments.[135] The agreement also stipulated that royalties for future inventions would be determined by the Manufacturers Aircraft Association on a case-by-case basis; and that the government could hand over designs of one company to another company for manufacture—provided that the latter paid a royalty of one percent of the purchase price of the aircraft.[136]

> In effect, the cross licensing agreement of 1917 established that the American aviation industry would operate without

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[132] ROLAND, *supra* note 123, at 38.
[133] *Id.*
[134] *See* Bittlingmayer, *supra* note 7, at 6, for a discussion of the Automobile Manufacturers Association and smog control.
[135] ROLAND, *supra* note 123, at 41.
[136] *Id.*

> major patents. Small royalties would be paid for certain contributions within the Manufacturers Aircraft Association, but in general the ideas and techniques of aircraft manufacturers were to be shared openly among the members.[137]

The patent cross licensing agreement also established criteria for membership in the Manufacturers Aircraft Association.[138] Hence, the original licensors appearing on the Association's roster included every leading pioneer in the then-nascent aircraft industry.[139] Furthermore, since the Wright Company had merged with the Martin Company, and the Curtiss Company had become consolidated with the Burgess Company, the principal airplane patents were now held by two companies.[140] Some of these early patents being licensed, as listed in Table 2, *infra*, were not only "interesting," but also "fundamental" to the evolution of advanced aircraft variants. As can be seen from this table of early patents, the original cross licensing agreement went to some length to limit its operation to "heavier-than-air-craft, using wing surfaces [and including] power plant appurtenances . . . but not to include the engine and engine accessories."[141]

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[137] *Id.*

[138] Membership was open to three types of entities: (1) any "responsible" present or potential airplane manufacturer; (2) any manufacturer to which the Federal Government had awarded a contract for ten or more airplanes; and (3) any owner of U.S. aircraft patents. *See* Joel I. Klein, Cross-Licensing and Antitrust Law, Address before the American Intellectual Property Law Association (May 2, 1997).

[139] These licensors included the Aeromarine Plane & Motor Company, Inc.; Boeing Airplane Company; Curtis Aeroplane and Motor Company, Inc.; Dayton Wright Company; G. Elias & Bro., Inc.; Gallaudet Aircraft Corporation; L.W.F. Engineering Company; Glenn L. Martin Company; Packard Motor Car Company; Sturtevant Aeroplane Company; Thomas-Morse Aircraft Corporation; and, Wright-Aeronautical Corporation. *See* Harry T. Dykman, *Patent Licensing within the Manufacturers Aircraft Association (MAA),* 46 J. PAT. OFF. SOC'Y 646, 648 (1964).

[140] *Id.*

[141] Bittlingmayer, *supra* note 7, at 26.

• Method of Getting a Hydroairplane Off of the Water into the Air	• Multiple Control System for Multiple Motored Aircraft
• Combination Land, Air and Water Craft	• Retractable Radiator
• Shop Inventions	• Detachable Stabilizer Fins for Flying Machines
• Means for Launching Flying Machines	• Heavier than Air Flying Machines
• Spoke Stays	• Folding Wing Aeroplane
• Improvements in Hydroaero Machines	• Autoplane

Table 2: Early patents that were fundamental to the evolution of advanced aircraft variants.[142]

Subsequently, the patent cross licensing agreement was amended as new developments occurred (e.g., patents pertaining to sound suppressors, fuel cells, ground effect vehicles, and new types of materials such as plastic, were excluded; but exhaust flow deflectors and guided missiles with winged surfaces were included), and survived until 1972 when it was challenged by the Department of Justice.[143] By the time the cross licensing agreement was abandoned through the 1975 consent decree, there were twenty members to the agreement.[144]

a. Economic Rationale

The Government claimed in its antitrust suit against the members of the Manufacturers Aircraft Association in 1972 that the patent cross licensing agreement of 1928 hampered competition in research and development and that the amount of R&D in the aircraft industry would be greater without the agreement.[145] But, according to George Bittlingmayer:

> One difficulty with this conception of the aim of the agreement is that the firms were free to compete for customers in other ways. Airplane producers could still offer lower prices and

[142] *Id.* at 648-649.
[143] *Id.*
[144] *Id.*
[145] *Id.* at 27.

> compete away to a large extent any savings from reduced R&D, and they could compete by offering new models based on existing jointly held patents. Perhaps more importantly, aircraft design and construction is very research-intensive to begin with, and research efforts can fruitfully be devoted to ends other than developing new patents. This is not to say that patentable ideas are not important.
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> . . .
>
> The notion that aircraft manufacturers would restrain themselves in other spheres is hard to sustain. Although the industry is and has been concentrated, a fact which seems to figure strongly in the Government's case, it is also marked by intense competition.
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> . . .
>
> The obvious and radical changes in airplane size, speed, reliability, safety and comfort that occurred over the years of the agreement also contribute to the impression that degree of product variety and the rate of progress in aircraft science make it difficult to collude by means of a patent pooling agreement of the sort under discussion here in a way that redistributes the gains of trade from consumers to producers. This somewhat cursory examination of conditions in the aircraft industry, as well as some straightforward economic agreements, suggest that if the agreement succeeded in curtailing R&D expenditures, it did not have any substantial or lasting effect on firm profitability. [146]

The most persuasive rationale, however, for answering the question of why the aircraft firms bothered to form a largely royalty-free patent cross licensing agreement comes from reconsidering the purpose of the patent system itself.[147] Based upon an analysis of a world with and without patents on airplane innovations, Bittlingmayer derived an ideal system for rewarding airplane innovations:

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[146] *Id.* at 27-28.
[147] *Id.* at 29.

> The ideal system would allow royalty-free access to all patents that would be discovered in the course of ordinary product development, and those for which the benefits, though not negligible, are not so great as to as to justify the delays and costs of defining and defending property rights and arranging licensing. Other discoveries for which the likelihood of discovery or the effort devoted to developing them does depend on a reward above and beyond airplane sales, and for which the benefits are in excess of transaction costs, would receive rewards. This determination would be made by an impartial body of experts who would also determine the royalties in order to eliminate the bargaining impasse and because there are economies of scope from making the two decisions jointly.[148]

A comparison of the NACA patent cross licensing agreement with Bittlingmayer's ideal system for rewarding airplane innovations is revealing in how well the "real" agreement conforms to the "ideal." Specifically, the NACA agreement:

- Was limited to an area where the holdout problem was more likely to occur, where the problems of determining the scope of patents might appear, and where the costs of obtaining permission to use numerous patents could be greatly economized;
- May have prevented situations in which association members could have blocked progress in an area; and
- Allowed the association to buy third party patents, which may have permitted association members to explore and develop an area without fear of patent infringement in cases where no individual firm had an incentive to purchase the relevant patent.[149]

It should be noted that allowing the association to buy third party patents did not stifle the incentives for third party patent holders to develop and file airplane patents.[150] Third party patent holders could sell their patents to an association member

[148] *Id.* at 34.
[149] *Id.* at 34-35.
[150] *Id.* at 35.

based on the "profit-maximizing" royalty, and then to others within the association based on the "most-favored-purchaser" clause.[151] In the words of Floyd L. Vaughn, the NACA patent cross licensing agreement was one of "[two] outstanding [patent] pools . . . which have lessened conflicts in technology and remained within the law."[152]

ii. NASA: Reviving the "Spirit of NACA?"

The structure of the aerospace industry in the United States and the rest of the world is like no other industry. Its key distinguishing characteristics, according to Dr. Henry Hertzfeld, include:

- A very few, large aerospace firms—with major production facilities—performing as systems integrators;
- A high proportion of space-related R&D funded by the government through direct contracts and Independent Research & Development (IR&D) agreements with large aerospace firms; and,
- A tendency for governments to use key aspects of space commerce for political bargaining purposes.[153]

Hence, for the top four U.S. aerospace corporations of today (i.e., Boeing, Lockheed-Martin, Northrop-Grumman, and Orbital Sciences), "the spirit of NACA" is embodied in the implementation of programs like NASA's *X-33* and Space Launch Initiative—the "next generation" of NASA/industry research partnerships.

Instituted to define technology requirements and next generation launch system needs to meet future government and commercial needs, NASA has provided billions of dollars to these companies to resolve fundamental issues such as market timing, architecture and system solutions, commercial conver-

[151] *Id.* at 35.
[152] *Id.* at 55.
[153] *See* H. Hertzfeld & R. Williamson, *Operating a Commercial Reusable Launch Vehicle: Economic, Legal, and Policy Considerations,* Paper (#IAA-01-IAA.1.1.05) *in* 52[ND] INTERNATIONAL ASTRONAUTICAL CONGRESS (Toulouse, France, Oct. 1, 2001).

gence, risk reduction, and competition.[154] Unfortunately, as previously discussed, *supra*;[155] these "next generation" partnerships have turned out to be nothing more than collusive agreements that "hampered competition in research and development"—and thus, innovation.

a. Economic Premise

The economic premise of the *X-33* and Space Launch Initiative programs is based on the following thesis: "the development of a commercial aerospace vehicle cannot emerge from a freely competitive, open marketplace where private demand and market forces are coupled with corporate research and development and production techniques."[156] Rather, some form of up-front government investment is necessary to prove the safety and viability of new, aerospace vehicle enabling technologies.[157] But this premise raises some interesting questions concerning market structure and the rate of introduction of inventions, as articulated by Edwin Mansfield:

> Suppose that an individual or firm invents a device that could be used profitably in a particular industry, but suppose also that the inventor is not a member of this industry and that consequently he must induce some firm in the industry to introduce it or enter the industry himself. For this type of invention, an important question is: What effect would a change in market structure have on the length of time that elapses before someone introduces the invention? This question has received considerable attention—both recently and in the past. On the one hand, there are some . . . who believe that inventions would be applied most rapidly under purely competitive conditions. They argue that if many firms exist, there is more protection against an invention's being blocked by the faulty judgment of only a few men. Moreover, they allege that the existence of many competitors will force a firm to seek out and

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[154] *See* SPACE and TECH, *NASA Awards U.S. $767 Million in Space Launch Initiative Contracts + Options,* (May 21, 2000), *available at* http://www.spaceandtech.com/digest/sd2001-20/sd2001-20-001.shtml.

[155] *See* the discussion in *Common Themes*, *supra* p. 149.

[156] *See* Stephens, *supra* note 13.

[157] *Id.*

> apply new ideas, whereas a live-and-let-live policy may develop otherwise.
>
> . . .
>
> On the other hand, there are others . . . who think that new ideas would be applied most rapidly if industries contained relatively few large firms. They point out that such firms are better able to finance the introduction of inventions and to take the necessary risks. In addition, they claim that large firms will have better managers who will be more inclined to innovate.[158]

Although, according to Mansfield, there is no evidence that one group's arguments are universally more valid than the others'; for the commercial space industry, it is obvious that government-sponsored, large firms are NOT the answer for introducing aerospace vehicle enabling technologies. The simple reason for this conclusion is that the four largest U.S. aerospace firms, as members of the LAF-boycott, have no incentive to create when they can simply lie back and receive large sums of money from NASA, without any risk, for merely studying "innovative ways" to either continually "reinvent the space launch wheel;"[159] or make the highly inefficient *Space Shuttle* "the B-52 of space!"[160]

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[158] Edwin Mansfield, *Size of Firm, Market Structure, and Innovation,* 71(6) J. POL. ECON. 556, 569 (1963).

[159] For NASA's latest "reinvention of the space launch wheel," check out its new *Crew Exploration Vehicle* (*CEV*), the *Space Shuttle*'s "next generation" successor. The *CEV* design is a throwback to the 1960's vintage *Apollo* Moon launch vehicle, except with a "reusable" capsule launched on top of an expendable in-line booster. Mike Griffin, NASA Administrator, said to think of the *CEV* as "Apollo on steroids." Like the *Apollo* missions, the *CEV* capsule would jettison its service module and return to Earth under parachutes, but will also use airbag cushions, retro-rockets or other means to land on the ground at a West Coast location. *Apollo* astronauts landed at sea. This approach is not very conducive to advancing the state of the art for RLVs. *See* Tariq Malik, *NASA's New Moon Plans: "Apollo on Steroids"* (Sep. 19, 2005), *available at* http://www.space.com/news/050919_nasa_moon.html.

[160] The comment about making the *Space Shuttle* "the B-52 of space" was made to the author by the new, incoming Vice President of Boeing's Human Space Flight & Engineering Division sometime in 2000. The new VP, basically, wanted to know why Boeing should be investing in a next-generation reusable launch vehicle when the company was making $1 billion a year, as a member of the United Space Alliance, simply launching and servicing the *Shuttle*. The VP then told the author that Boeing's strategy was to

B. Government/Large-Aerospace-Firm Boycott

The complexity of space technology affects how firms use their newly developed technologies. Generally, complex technologies and products permit "inventing around." However, to limit the "inventing around" capabilities of the small aerospace firms, the government-sponsored large aerospace firms (through their government-exclusive contracts) patent many alternate techniques for the same invention, thus building strategic patent portfolios. As a result, "winner-take-all" patent races and Schumpetarian replacement no longer characterize technological competition.[161] Instead, large aerospace firms perpetually "hold" their newly-developed, multiple-overlapping patents within the government/large-aerospace-firm relationship and thus create persistent oligopolies.

These persistent oligopolies, in turn, force innovating small aerospace firm entrants to pay high rents to the government/large-aerospace-firm incumbents, which are the equivalent of a private "patent tax." This tax is thus a transaction cost that takes the form of "lost opportunity costs" to small aerospace firms because of the unreasonably long time delays associated

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"make the Shuttle 'the B-52 of space' by finding innovative ways to keep it flying forever; the same way Boeing has done it for the U.S. Air Force with the B-52."

[161] *See* JAMES E. BESSEN, PATENT THICKETS: STRATEGIC PATENTING OF COMPLEX TECHNOLOGIES 3 (Research on Innovation, Working Paper, 2003). Schumpeter assessed the role of innovative activity in economic development, which led him to new theories concerning the importance of market power and firm size in stimulating the innovative activities of firms. However, empirical testing of these theories relies on two interpretations of Schumpeter's findings: innovative activity increases (1) with market power; and (2) more than proportionally with firm size. Two different effects were found regarding market power. The first effect, anticipated *ex-post* market power (secured by patents, technological advance or secrecy), ensures a better appropriation of innovation output, thus enhancing innovative activity. The second, *ex ante* market power, is much more controversial. On the one hand, the replacement effect discourages firms already holding market power to invest in research, because gains from new innovations will only replace current gains. On the other hand, the efficiency effect acts as a stronger spur to innovation for firms already holding market power, because they will not have to face competition when they exploit the new innovation. The replacement effect best describes the government-sponsored large-aerospace-firms. However, the efficiency effect does not act as a stronger spur to innovation for government-sponsored large-aerospace-firms because these firms serve a government-created market where there is no incentive to exploit new innovations. *See* Bruno Crepon et al., *Schumpeterian Conjectures: A Moderate Support from Various Innovation Measures,* 11TH JOURNÉES DE MICROÉCONOMIE APPLIQUÉE, Marseille, France (1994) (*revised* 1995).

with obtaining licenses on patents developed with public funds. A perfect example (and, a common one among small aerospace firms) can be seen in a recent *NASA Notice of Prospective Patent License: Bigelow Development Aerospace Division, L.L.C.*, which states:

> NASA hereby gives notice that Bigelow . . . has applied for an exclusive license to practice the invention described and claimed in Patent No. 6,354,540 . . . . The patent is assigned to the United States of America as represented by the Administrator of the National Aeronautics and Space Administration. Written objections to the prospective grant of a license should be sent to the Johnson Space Center. NASA has not yet made a determination to grant the requested license and may deny the requested license even if no objections are submitted within the comment period.[162]

Clearly, there is no guarantee that small aerospace firms can obtain *ex post* licenses on patents developed by the LAF-boycott using public funds. From the language of the NASA notice, it appears that the boycott can either "hold up" similar technologies in other small aerospace firm products, or obtain the equivalent of "blocking patents" on different technical functions used in the same products. Unless small aerospace firm entrants can obtain *ex ante* licenses—and evidence suggests that they do not do so for good reason (as exhibited by the example, *supra*)—these "patent taxes" significantly inhibit innovation by small aerospace entrants.

i. Legal Basis

The legal basis for the LAF-boycott can be traced, indirectly, to the Bayh-Dole Act, Pub. L. No. 96-517.[163] The intent of the Act, as articulated in the House Judiciary Committee report to accompany the relevant bill, was to:

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[162] NASA Notice, 69 Fed. Reg. 50,402 (Aug. 16, 2004). The outcome of Bigelow's application is unknown.

[163] Government Patent Policy Act of 1980, Pub. L. No. 96-517 (codified as amended in 35 U.S.C. §§ 200 to 212).

> [replace] . . . the existing mélange of 26 different agency policies on vesting of patent rights in government funded research . . . [with] a single, uniform national policy designed to cut down on bureaucracy and encourage private industry to utilize government funded inventions through the commitment of the risk capital necessary to develop such inventions to the point of commercial application.[164]

Bayh-Dole, by providing universities, nonprofit institutions, and small businesses (small aerospace firms) with patent ownership rights arising from federally funded research and development, offers an incentive for cooperative work and commercial application.[165]

Although the Bayh-Dole Act, as passed by Congress, was silent on the rights of large business contractors (large aerospace firms), bills aiming to unify the treatment of large and small contractors were introduced in subsequent Congresses. To this day, it is only by virtue of a *Memorandum to the Heads of Executive Departments and Agencies*, signed by President Reagan in 1983, and quietly endorsed by Congress in an inconspicuous housekeeping provision to a 1984 change in the law, that large aerospace firms enjoy the benefits that Congress explicitly provided only for small aerospace firms under the terms of the Bayh-Dole Act.[166]

Furthermore, Congress included a provision in the Bayh-Dole Act to deal with situations where if the original licensee fails, under certain circumstances, to commercialize a federally-funded technology, then another party may elect to do so. This provision, known as "march-in rights," permits a third party to petition the government to "march in" and force the entity to grant the petitioner a license when, for example, the original licensee is unable (or unwilling) to commercially exploit the

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[164] House Committee on the Judiciary, *Report to Accompany H.R. 6933,* 96th Cong. 2nd sess., 1980, H. Rept. 96-1307, Part 1, 3.

[165] WENDY H. SCHACHT, CONGRESSIONAL RESEARCH SERVICE, PATENT OWNERSHIP AND FEDERAL RESEARCH AND DEVELOPMENT (R&D): A DISCUSSION ON THE BAYH-DOLE ACT AND THE STEVENSON-WYDLER ACT, CRS-4 (2000).

[166] Rebecca S. Eisenberg, *Public Research and Private Development: Patents and Technology Transfer in Government Sponsored Research,* 82 VA. L. REV. 1663, 1694 (1996).

technology.[167] However, throughout the Act's 28-year existence, no "march-in right" attempt has succeeded.[168]

Hence, small aerospace firms have not been allowed to capitalize on the federally funded technology development efforts provided by the U.S. Government to the top four U.S. large aerospace firms. Nowhere is this more evident than in NASA's *2nd Generation RLV Task Awards NRA 8-30*, where NASA awarded technology development contracts for space transportation valued at $766.9 million to 22 contractors and universities, covering 37 different task awards.[169] The bulk of this money, $584.4 million (76% of the total award), centered on five contracts for overall system studies and two flight demonstrations, was awarded to Boeing, Lockheed Martin, Northrop-Grumman, and Orbital Sciences Corporations.[170] Naturally, these four companies spent just enough company funds to declare their "designs" proprietary creations, thus ensuring that the federal money contributed to their research did not ultimately benefit the public.[171] Although the Bayh-Dole Act did not directly contribute to the large aerospace firm SLI contract awards, its ability to "level the IP-sharing playing field" for small aerospace firms has been effectively neutralized.

Consequently, government-sponsored large aerospace firms have created high barriers to AV market entry for non-government-sponsored small aerospace firms. In fact, it is probably safe to say that the government, acting in collusion with the large aerospace firms through exclusive contracting practices, has created a de facto Federal monopoly on all AV

[167] Mary Eberle, *March-In Rights under the Bayh-Dole Act: Public Access to Federally Funded Research,* 3 MARQ. INTELL. PROP. L. REV. 155, 156 (1999).

[168] *Id.*

[169] *See* SPACE and TECH, *supra* note 154.

[170] *Id*.

[171] NASA's contribution to the program was fixed—with industry partners responsible for costs exceeding the initial agreement. A contingency plan on what to do if industry was unwilling to cover additional costs was not developed. This is because NASA assumed that the projected growth in the launch market would provide the necessary incentive to sustain industry contributions. *Space Launch Initiative: A Program Review: Hearing Before the Subcomm. On Space and Aeronautics of the House Comm. On Science,* 107th Cong. 38 (2001) (testimony of Allen Li).

technology development activities.[172] To make matters worse, the LAF-boycott's control over AV technology development is virtually total, as summed up by a senior manager at a large domestic aerospace company: "if NASA or the Air Force doesn't want it, we're not doing it."[173] The small, non-government-sponsored aerospace firms simply do not have the financial wherewithal to overcome this hurdle.

ii. Cooperative Agreements

As previously discussed, *supra*, the contractual vehicle of choice employed by the LAF-boycott is the cooperative agreement. Although cooperative agreements are, ostensibly, a means for jointly funding and implementing activities to achieve common government/industry objectives; they are, in reality, one-sided agreements that unfairly benefit the "bottom lines" of government/large-aerospace-firm incumbents at the taxpayers' expense. The classic example of this assertion is the cooperative agreement that governed the *X-33 Program*.

From a financial perspective, Lockheed Martin and its partners made out pretty well.[174] Under the *X-33* cooperative agreement, NASA's contribution was to be $912.4 million, and Lockheed Martin's and its industry partners': $211.6 million.[175] However, procurement regulations allowed these companies to recover allowable independent research and development (IR&D) costs by including them as overhead in the pricing of their other government contracts.[176] As a result, when government costs for NASA civil service personnel working on the program were taken into account, "a more accurate representation of the esti-

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172 BIGELOW AEROSPACE & PATTON BOGGS LLP, BEYOND THE SATELLITES: STIMULATING A NEW WAVE OF COMMERCIAL SPACE DEVELOPMENT 13 (2000) *available at* http://www.nidsci.org/pdf/space_commercialization.pdf.

173 *Id.*

174 Recall, *supra* note 84, Lockheed Martin's industry partners included Allied-Signal Aerospace, B.F. Goodrich Aerospace, Boeing-Rocketdyne Division, and Sverdrup Corporation.

175 Although Lockheed Martin pledged at least $211.6 million, its contribution grew $75 million above that original estimate, to a total of $286.6 million. *See* STATUS OF THE X-33, *supra* note 84, at 1-2.

176 *See* STATUS OF THE X-33, *supra* note 84, at 2.

mated government's share of the X-33 Program [was] $1.23 billion, while industry's estimated share [was] $125.4 million."[177]

Lockheed Martin and its industry partners also did quite well in the IP-acquisition department. But, how could Lockheed Martin and its partners lose when they had the best of all "IP-rights" worlds? The *X-33* Cooperative Agreement Notice, dated January 1995, provided specific patent retention rights for both large businesses and small businesses.[178] The minimum patent rights to a large business contractor were contained in Attachment I of the Notice, and stated:

> The Contractor is hereby granted a revocable, non-exclusive, royalty-free license in each patent application filed in any country on a contractor subject invention and any resulting patent in which the Government acquires title . . . The Contractor's license extends to its domestic subsidiaries and affiliates, if any, within the corporate structure of which the Contractor is a party and includes the right to grant sublicenses of the same scope to the extent the Contractor was legally obligated to do so at the time the contract was awarded . . . .[179]

On the other hand, the principal patent rights to a small business contractor, contained in Attachment II, stated:

> The Contractor may retain the entire right, title, and interest throughout the world to each subject invention subject to the provisions of this clause and 35 U.S.C. 203. With respect to any subject invention in which the Contractor retains title, the Federal Government shall have a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for on behalf of the United States the subject invention throughout the world.[180]

Both attachments provided for "march-in rights" in accordance with 35 U.S.C. 203, the Bayh-Dole Act, as follows:

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[177] For a total program cost of $1.3554 billion. *Id*.

[178] *See* Island One Society, *A Cooperative Agreement Notice: Reusable Launch Vehicle (RLV) Advanced Technology Demonstrator X-33* (Jan. 1995), *available at* http://www.islandone.org/Launch/X33-CAN.html.

[179] *Id.*

[180] *Id.*

> The Contractor agrees that, with respect to any subject invention in which it has acquired title, NASA has the right . . . to require the Contractor, an assignee or exclusive licensee of a subject invention to grant a non-exclusive, partially exclusive, or exclusive license in any field of use to a responsible applicant or applicants, upon terms that are reasonable under the circumstances, and if the Subcontractor, assignee, or exclusive licensee refuses such a request NASA has the right to grant such license itself if the Federal agency determines that . . . (1) Such action is necessary because the Contractor or assignee has not taken, or is not expected to take within a reasonable time, effective steps to achieve practical application of the subject invention in such field of use . . . .[181]

There were three additional conditions under which NASA could enforce "march-in rights," but they were secondary to the primary one described, *supra*.[182]

Clearly, Lockheed Martin's *X-33* advanced technology demonstrator design was the "most technically risky of the three leading concepts" considered by NASA.[183] In fact, McDonnell Douglas' entry, a *DC-X* derivative vehicle, was probably rated as more "likely to succeed at demonstrating an operational RLV capability."[184] To add insult to injury, neither NASA nor Lockheed Martin was willing to pay for the inevitable cost overruns that followed in the wake of the *X-33 Program*'s technical prob-

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[181] *Id.*

[182] Of the remaining three conditions, however, the next most apropos to this thesis is: ". . . (3) Such action is necessary to meet requirements for public use specified by Federal regulations and such requirements are not reasonably satisfied by the Contractor, assignee, or licensees . . . ." *Id.*

[183] *See* Charles Miller & Jeff Foust, *The Vision for Space Exploration and the retirement of the Baby Boomers (part 3)* (Jun. 16, 2008), *available at* http://www.thespacereview.com/article/1152/1.

[184] *Id.* The *DC-X—Delta Clipper-Experimental*—was a 1/3 scale, advanced technology demonstrator of a planned *DC-Y* vertical-takeoff/vertical-landing (VTOVL), single stage to orbit prototype. Under a two-year, $58-million contract for the Strategic Defense Initiative Office, Single Stage Rocket Technology program, McDonnell Douglas Space Systems Company (MDSSC) and its team-mates used rapid prototype techniques to design and build the *DC-X* and its associated ground support and operations systems. The *DC-X*, through a series of twelve successful flights, verified vertical takeoff and landing capabilities; demonstrated subsonic maneuverability; validated "aircraft-like" reliability, maintainability, supportability, and availability (RMS&A) concepts; and demonstrated the rapid prototyping development approach for VTOVL RLVs. *See* Mark Wade, *DC-X* (2007), *available at* http://www.astronautix.com/lvs/dcx.htm.

lems. [185] Regardless of what its grand strategy was, however, it is evident that Lockheed Martin—a member of the present-day LAF-boycott[186]—succeeded in:

1. Keeping a challenger, McDonnell Douglas, from entering the AV development field with a superior, flight-proven technical design by promising NASA to invest at least $211.6 million of its own funds;[187]

2. Securing de facto, exclusive IP rights in a plethora of new technologies and know-how through the "Bayh-Dole loophole;" the backdoor to the more generous, "small business contractor" patent rights clause (Attachment II, discussed *supra*) in the cooperative agreement; [188] and,

3. Maintaining a strangle-hold on its lucrative expendable launch vehicle and Space Shuttle launch services contracts with the Federal Government.[189]

iii. Patent Thickets

Today's government-sponsored, large aerospace firm inventors stand on top of a huge intellectual property pyramid that has been carefully constructed by "blocking patents," which are analogous to a pyramid's building blocks.[190] With cumulative

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[185] *See* Miller & Foust, *supra* note 183.

[186] Adam Bryant, *McDonnell Douglas-Boeing Merger Wins F.T.C. Approval*, NEW YORK TIMES, July 2, 1997, http://www.nytimes.com/1997/07/02/business/mcdonnell-douglas-boeing-merger-wins-ftc-approval.html.

[187] Lockheed Martin was able to do this because it had the financial resources to contribute $211.6 million, whereas McDonnell Douglas did not. Hence, Lockheed Martin was literally able to "buy" the *X-33* Program contract from NASA in order to eliminate the only competitor capable of outperforming it in the AV development field. This incident clearly shows that even among the large aerospace companies, there is internecine warfare as each tries to better the other in an otherwise extremely competitive field. *See also* STATUS OF THE X-33, *supra* note 84, at 2.

[188] Recall, the "Bayh-Dole backdoor" is the *Memorandum to the Heads of Executive Departments and Agencies,* previously discussed, *supra*. Through this "backdoor," Lockheed Martin purchased $1.3554 billion worth of exclusive IP rights for a net price of $125.4 million—over a 90% discount, and a real bargain!

[189] Recall, *supra* note 160, Boeing's strategy to "make the Shuttle the B-52 of space."

[190] Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting, in* 1 INNOVATION POLICY AND THE ECONOMY 119, 120 (Adam B. Jaffe et al. eds., 2001) *available at:* http://faculty.haas.berkeley.edu/shapiro/thicket.pdf.

innovation and multiple blocking patents, strong patent rights—like those granted in government-sponsored cooperative agreements—can create "patent thickets" that stifle, rather than encourage innovation.[191] A "patent thicket" is an overlapping set of patent rights requiring companies seeking to commercialize their new technologies to obtain licenses from multiple patentees. Needless to say, the classical "patent thicket" problem confronting small aerospace firm entrants has been exacerbated by the LAF-boycott. In the words of Carl Shapiro:

> [The U.S.] patent system, while surely a spur to innovation overall, is in danger of imposing an unnecessary drag on innovation by enabling multiple rights owners to "tax" new products, processes and even business methods. The vast number of patents currently being issued creates a very real danger that a single product or service will infringe on many patents. Worse yet, many patents cover products or processes already being widely used when the patent issued, making it harder for the companies actually building businesses and manufacturing products to invent around these patents [(i.e., the classic "hold-up" problem)]. Add in the fact that the patent holder can seek injunctive relief, etc., can threaten to shut down the operations of the infringing company, and the possibility for "hold up" becomes all too real.[192]

In short, with the multiple overlapping patents generated by the LAF-boycott, and under a system in which patent applications are secret[193] and patents slow to issue (relative to the speed of new product introduction), there is a volatile mix of two powerful types of "transaction costs" that can burden small aerospace firm innovation.[194] These transaction costs include:

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[191] *Id.*

[192] *Id.* at 121.

[193] Within the legislative foundation for government-sponsored R&D via cooperative agreements, the government is "authorized" to withhold public disclosure of information for a "reasonable time" until a patent application can be made. This provision supplements existing patent law (35 U.S.C. 205) that prohibits the Patent and Trademark Office from releasing information associated with a patent before it is issued. *See* SCHACHT, *supra* note 165, at CRS-5.

[194] Shapiro, *supra* note 190, at 126.

(1) The "complements" problem, the solution of which requires extensive coordination through the use of either cross licenses, package licenses, or patent pools to clear blocking positions;[195] and,

(2) The "hold-up" problem, which is resistant to a solution in the absence of either:

(a) Better information at an earlier stage about patents likely to issue; and/or,

(b) The ability of small aerospace firms to challenge LAF-boycott patents at the PTO before they have issued and are given some presumption of validity by the Courts.[196]

The LAF-boycott has, in essence, not only created a "complementary patent thicket" of its own, but a "hold-up" problem as well for small aerospace firms. This is because small aerospace firms are "forced" to coordinate with LAF-boycott patent rights holders to solve "complements problems," thus facing two obstacles. First, there are large coordination costs that must be overcome.[197] Second, antitrust sensitivities may be heightened when small aerospace firms combine their assets, jointly set fees of any sort, or even talk directly with one another in an effort to "design around" the LAF-boycott patent rights through cooperative cross licensing and patent pooling.[198] As for the "hold-up" problem, there is very little small aerospace firms can do to

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[195] *Id.* at 123.

[196] *Id.* at 126. A classic example of this, although not on all four corners in re this thesis, is the Boeing Company's recent refusal to allow SES Americom to use a Boeing-patented process to bring SES's stranded *AMC-14* geostationary (GEO) satellite back via the Moon to a stable GEO orbit; where the satellite could have operated for at least four years, or longer. The satellite was launched in March 2008 by a *Proton* launch vehicle into space just short of its minimum geostationary transfer orbit (GTO). Industry sources told *SpaceDaily*, an internet-based space-related newsletter, that "the patent is regarded as legal 'trite', as basic physics has been rebranded as a 'process', and that the patent wouldn't stand up to any significant level of court scrutiny and was only registered at the time as 'the patent office was incompetent when it came to space matters.'" *See* SPACE TRAVEL, *Boeing Patent Shuts Down AMC-14 Lunar Flyby Salvage Attempt,* (Apr. 10, 2008), *at* http://www.space-travel.com/reports/Boeing_Patent_Shuts_Down_AMC_14_Lunar_Flyby_Salvage_Attempt_999.html.

[197] Shapiro, *supra* note 190, at 126.

[198] *Id.*

overcome it without reform of the patent system itself, or other legislative relief.[199]

iv. Antitrust Challenges

As previously discussed, *supra*, the Federal Government indirectly controls and dictates the activities of small entrepreneurial space companies through its sponsorship of the LAF-boycott and thus directly affects all AV technology development activities. In fact, this de facto government space monopoly has never grown beyond its government-sponsored inception because it is inherently inefficient.[200] One aspect of this monopoly is the Federal dominance of the manned space launch industry, which has stymied, rather than promoted, the development of enabling AV technologies. Specifically:

> On the manned side, here in the U.S., we have a de facto Federal monopoly on all manned space activities. Nobody but the feds fly manned missions. Over the years, this taxpayer supported monopoly has been particularly resistant to breaking. One of the things that a [bureaucracy] will tend to do over time is to do things that will maintain that monopoly and expand its size, scope and authority. A federal, taxpayer supported bureaucracy will be particularly resistant to giving up its monopoly unless forced to do so.[201]

Although many private space launch start-up companies have attempted to break the LAF-boycott stranglehold, none have been successful. One of the first bona fide companies to "tilt at the LAF-boycott windmill" was Beal Aerospace in 1997.[202]

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[199] *Id*.

[200] *See* BIGELOW AEROSPACE & PATTON BOGGS LLP, *supra* note 172, at 13.

[201] Attributed to Alex Gimarc in his paper, *Motivating the Bureaucracy. See* BIGELOW AEROSPACE & PATTON BOGGS LLP, *supra* note 172, at 13.

[202] "Andrew Beal founded Beal Aerospace in 1997 when he saw an opportunity to enter what promised to be a rapidly growing satellite launch market. Unlike a number of reusable launch vehicle (RLV) companies that started up around the same time, Beal focused on developing a powerful but simpler, and hence less expensive, expendable rocket that would go after the lucrative geosynchronous communications satellite market. Beal also set itself apart from other entrepreneurial launch companies through its funding. Rather than seek venture capital, as RLV companies did with limited success, Andrew Beal funded the company using the profits from Beal Bank, of which he owns 99

However, following three years of cost overruns and schedule delays in the development of its *BA-2* expendable launch vehicle, Beal announced its demise with a statement that those problems were not the root causes of the company's shutdown.[203] Rather:

> Beal blamed the government, particularly the Space Launch Initiative (SLI), a new NASA effort to fund launch vehicle development and the Air Force's Evolved Expendable Launch Vehicle (EELV) program, which is supporting development of new versions of Boeing's Delta and Lockheed Martin's Atlas boosters.
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> . . .
>
> 'The most insurmountable risk is the desire of the U.S. Government and NASA to subsidize competing launch systems . . . NASA has embarked on a plan to develop a second-generation launch system that will be subsidized by U.S. taxpayers and that will compete with the private sector.'
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> . . .
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> 'We find it inexcusable and intolerable that NASA [and the U.S. Government] intend for these subsidized systems to additionally compete for non-human-rated missions, including cargo for the space station and commercial satellite missions.'[204]

These complaints concerning the LAF-boycott are recurring themes in the challenges that follow.

a. SpaceX v. Boeing and Lockheed Martin

Unlike Beal Aerospace, Space Exploration Technologies Corporation (hereinafter "SpaceX") sued The Boeing Company and Lockheed Martin Corporation for violations of antitrust,

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percent." *See* Jeff Foust, *Beal Aerospace Shuts Down; Cites "Intolerable" Gov't Interference As Factor* (Oct. 23, 2000), *available at* http://www.space.com/businesstechnology/business/beal_aero_over_001023.html.

[203] *Id.*

[204] *Id.*

unfair competition, and racketeering laws relative to Boeing and Lockheed Martin's efforts to secure exclusive EELV contracts; and form a joint venture that would combine their EELV launch businesses into a single entity—the United Launch Alliance (ULA).[205] SpaceX alleged that it posed a significant threat to Boeing and Lockheed Martin's dominant position because it had developed new technologies and a new business model that would allow it to dramatically reduce the cost of access to space and increase the reliability of launch vehicles.[206] SpaceX further alleged that the rockets it was developing would perform better, and be much less expensive, than those offered by Boeing or Lockheed Martin.[207]

The crux of SpaceX's argument was that Boeing and Lockheed Martin had caused injury to competition and SpaceX in both the government and commercial space launch markets, as follows:

> Boeing and Lockheed Martin's conspiracy and anticompetitive acts in furtherance of their conspiracy have substantially and adversely affected competition in the sale of EELVs and launch services to government and commercial customers, and have caused direct and significant injury to SpaceX.[208]
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> . . .
>
> Boeing and Lockheed Martin's unlawful agreement and conduct has foreclosed competition from other EELV providers (including SpaceX) and has allowed one or both of Defendants to maintain market power (and collectively to control virtually

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[205] Specifically, the SpaceX complaint comprised eight causes of action, including: (1) Violation of Section 1 of the Sherman Act; (2) Violation of Section 2 of the Sherman Act; (3) Violation of Section 7 of the Clayton Act; (4) Violation of Racketeer Influenced and Corrupt Organizations Act; (5) RICO Conspiracy; (6) Violation of the Cartwright Act (unreasonable Restraint of Trade; (7) Violation of the Cartwright Act (Conspiracy to Monopolize); and (8) Violation of Section 17200 of Cal. Bus. & Prof. Code. *See* Plaintiff's Complaint, Space Exploration Technologies Corporation v. The Boeing Company and Lockheed Martin Corporation, Case No. CV05-7533 FMC (MANx) (C.D. Cal. 2005) (No. 17, 23).

[206] Plaintiff's Complaint supra note *205*, at para. 4, *Space Exploration Technologies Corporation* (No. 17, 23).

[207] *Id.*

[208] *Id.* at para. 57.

> a 100% share) in the market for the sale of EELVs and related launch services to the U.S. Air Force, as agent of the U.S. Government. Defendants' conduct has precluded current and future competition in this market, thereby protecting their dominant position and ensuring that U.S. Government customers pay higher prices.[209]
>
> . . .
>
> There is a dangerous probability that Boeing and Lockheed Martin's unlawful agreement and conduct will allow the companies to acquire and maintain market power in the market for the sale of EELVs and related launch services to commercial customers.[210]

The District Court's decision against SpaceX, however, centered on standing[211] and ripeness. The central issue in this case was whether SpaceX had suffered an injury in fact.[212] The Court found that:

1. An earlier Court of Federal Claims decision (hereinafter "COFC decision")[213] conclusively established that the current

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[209] *Id.* at para. 65.

[210] *Id* at para. 66.

[211] Standing "is an essential and unchanging part of the case-or-controversy requirement of Article III." Lujan v. Defenders of Wildlife, 504 U.S. 555, 560 (1992), *quoted in* Order Granting Motions to Dismiss, at 8, Space Exploration Technologies Corporation v. The Boeing Company and Lockheed Martin Corporation, Case No. CV05-7533 FMC (MANx) (C.D. Cal. 2006) (No. 17, 23), *aff'd,* No. 06-55907, 2008 WL 2340555, at *1 (C.A. 9 (Cal.) Jun. 9, 2008). The Supreme Court has established that the "irreducible constitutional minimum" of standing contains three elements: (1) the plaintiff must have suffered an "injury in fact"—an invasion of a legally protected interest which is concrete and particularized and actual or imminent, not conjectural or hypothetical; (2) a causal connection between the injury and the conduct complained of—the injury has to be fairly traceable to the challenged action of the defendant, and not the result of the independent action of some third party not before the court; and (3) likelihood that the injury will be redressed by a favorable decision. *Lujan*, 504 U.S. at 560, *cited with approval in* Order Granting Motions to Dismiss at 8-9, *Space Exploration Technologies Corporation* (No. 17, 23).

[212] To meet this requirement, a plaintiff must allege harm that is "distinct and palpable" rather than "abstract[,] conjectural[,] or hypothetical." Idaho Conservation League v. Mumma, 956 F.2d 1508, 1514 (9th Cir. 1992) (internal quotation marks and citation omitted), *quoted in* Order Granting Motions to Dismiss at 9, *Space Exploration Technologies Corporation* (No. 17, 23).

[213] *See* Space Exploration Technologies Corporation v. United States, 68 Fed Cl. 1 (2005).

Air Force EELV request for proposal (RFP) covered only launches awarded through fiscal year 2006, and that SpaceX would not be able to offer an EELV until at least 2007;

2. SpaceX had not alleged any injury based on the award of infrastructure subsidy payments because, under the terms of the relevant RFP, SpaceX was not eligible to bid—SpaceX did not have launch capability at the time of the RFP (April 6, 2005), and therefore was not a qualified bidder. Hence, in the absence of a right to bid, SpaceX could not have suffered an injury in fact;[214] and,

3. Despite repeated conclusory and vague references to harm suffered; SpaceX's argument was utterly devoid of any concrete factual allegations regarding any type of actual injury suffered.[215]

However, SpaceX argued that at least one of the antitrust laws upon which it based its claims—§ 7 of the Clayton Act—is "forward-looking and doesn't require actual past injury."[216] The Court, citing *Lujan v. Defenders of Wildlife*, 504 U.S. 555 (1992), found:

> Although under certain circumstances, injunctive relief is available to a plaintiff without actual past injury, an antitrust plaintiff is not relieved of the constitutional requirement that the threatened injury be "imminent" . . . Here, SpaceX's contention does not take into account that it is not yet in a position to compete with Defendants. Until it is, such a claim is unripe.[217]

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[214] Order Granting Motions to Dismiss, at 10, *Space Exploration Technologies Corporation* (No. 17, 23).

[215] *Id.* at 11.

[216] *Id.* at 11, n.4., § 7 of the Clayton Act states, in part: "No person shall acquire, directly or indirectly . . . any part of the assets of one or more persons engaged in commerce or in any activity affecting commerce, where in any line of commerce in any section of the country, the effect of such acquisition . . . may be substantially to lessen competition, or to tend to create a monopoly." *See* 15 U.S.C. § 18 (1996).

[217] Order Granting Motions to Dismiss, at 11 n.4, *Space Exploration Technologies Corporation* (No. 17, 23).

b. In the Matter of ULA

In May 2005, The Boeing Company and Lockheed Martin Corporation agreed to form a joint venture, United Launch Alliance (ULA), to consolidate the manufacturing and development activities of their respective expendable launch vehicles (ELV).[218] In addition, the ULA "merger" included the sale of launch services to the U.S. Government—sales to the commercial sector, however, would still be conducted separately by each company.[219]

The Federal Trade Commission (FTC) announced its decision to intervene in the formation of ULA in October 2006, and issued its *Decision and Order* on May 1, 2007.[220] According to the FTC's complaint, "the proposed joint venture would violate Section 7 of the Clayton Act[[221]] and Section 5 of the FTC Act,[[222]] as amended, by substantially lessening competition in the U.S. markets for government MTH [(medium to heavy)] launch services and space vehicles."[223] Nevertheless, the principal issue that emerged before the Commission during its review of this matter was "balancing the loss of direct competition between Boeing and Lockheed Martin with the potential national secu-

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[218] *See* Press Release, Federal Trade Commission, FTC Intervenes in Formation of ULA Joint Venture by Boeing and Lockheed Martin (Oct. 3, 2006), *available at* http://www.ftc.gov/opa/2006/10/ula.shtm.

[219] *Id.*

[220] *Id. See also* FTC Decision and Order at 21, In the Matter of Lockheed Martin Corporation, The Boeing Company, and United Launch Alliance, L.L.C. (May 1, 2007) (No. C-4188) *available at* http://www.ftc.gov/os/caselist/0510165/0510165do.pdf.

[221] *See supra* note 216.

[222] § 5(a)(1) of the FTC Act states: "Unfair methods of competition in or affecting commerce, and unfair or deceptive acts or practices in or affecting commerce, are hereby declared unlawful." *See* 15 U.S.C. § 5 (1994).

[223] Boeing and Lockheed Martin are the only competitors in the U.S. market for government-sponsored MTH launch services; whereas, Boeing, Lockheed Martin, and Northrop Grumman account for the vast majority of sales in the U.S. market for space vehicles. *See* Press Release, Federal Trade Commission, *supra* note 218. "Space Vehicle" means a spacecraft or multiple spacecrafts . . . to be launched to low earth orbit . . . or . . . to higher orbital parameters . . . with the capability of performing various scientific, military, exploration, observation, intelligence, reconnaissance, communication or other space missions. FTC Decision and Order at 5, *In the Matter of Lockheed Martin Corporation, The Boeing Company, and United Launch Alliance, L.L.C.* (No. C-4188) *available at* http://www.ftc.gov/os/caselist/0510165/0510165do.pdf.

rity advances resulting from ULA."[224] Following a thorough review and close consultation with the Department of Defense (DoD), the Commission voted to approve the consent order by a 5 – 0 margin, with Commissioner Pamela Jones Harbour issuing a separate concurring statement.[225] The terms of the consent order required Boeing and Lockheed Martin to take the following actions:

1. ULA must cooperate on equivalent terms with all providers of government space vehicles;[226]

2. Boeing and Lockheed's space vehicle businesses must provide equal consideration and support to all launch services providers when seeking any U.S. Government delivery in orbit contract;[227] and

3. Boeing, Lockheed and ULA must safeguard competitively sensitive information obtained from other space vehicle and launch services providers.[228]

However, the order did not attempt to remedy the loss of direct competition between Boeing and Lockheed Martin.[229] Instead, the order addressed the ancillary competitive harms that the

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[224] Letter from Donald S. Clark, Secretary, Federal Trade Commission, to Lawrence Williams, Vice President, Space Exploration Technologies Corporation (May 1, 2007), *available at* http://www.ftc.gov/os/caselist/0510165/0510165lettertoSETC.pdf.

[225] *See* Press Release, Federal Trade Commission, *supra* note 218.

[226] This provision is intended to ensure that ULA cannot give unfair advantage to the space vehicle businesses of its parent companies, Boeing and Lockheed, during DoD's space vehicle procurement process.

[227] This provision is intended to prevent Boeing and Lockheed from discriminating against nascent government MTH launch services suppliers, like SpaceX, in order to protect ULA's monopoly status.

[228] *See* Press Release, Federal Trade Commission, *supra* note 218.

[229] Clearly, the national security issues were legitimate. The DoD informed the Commission that the creation of ULA would advance national security by improving the United States' ability to reliably access space. And, because access to space was essential to the U.S. military, maximizing the reliability of launch vehicles was of paramount importance. Hence, ULA would improve launch vehicle reliability through a single work force that would benefit from an increased launch tempo and because ULA would integrate Boeing's and Lockheed Martin's complementary technologies. *See* Press Release, Federal Trade Commission, *supra* note 218.

DoD identified, without interfering with ULA's national security benefits.[230]

In her concurring statement, Commissioner Pamela Jones Harbour agreed that "significant anticompetitive effects, including the loss of potential future price competition, are likely to occur if the proposed transaction is consummated."[231] Ms. Harbour also stated that if the ULA joint venture had been scrutinized through a competition lens, she would have had no choice but to vote for a Commission challenge.[232] Although Ms. Harbour voted in favor of accepting the proposed ULA consent agreement, she nevertheless noted "a few troublesome aspects." Specifically:

> The proposed consent agreement departs radically from traditional Commission consent orders in merger cases. Structural remedies are, by far, the preferred way to resolve competitive problems in the horizontal merger context. Conduct restrictions, standing alone, generally are viewed as insufficient to address the underlying market mechanisms from which competitive harm may arise. Here, in lieu of market-based competition, the monopolist ULA will be subjected to an elaborate and highly regulatory system of oversight by a "compliance officer" appointed by the Secretary of Defense. Ordinarily, such a system would not be considered an effective remedy for the anticompetitive effects alleged in the Commission's complaint . . . I continue to believe that preserving a competitive market structure is the preferred "fix" for an anticompetitive horizontal merger.[233]

C. AV Development: A New Paradigm

The foregoing discussions have revealed much about the technical, economic, and political environments in which the development of AV-enabling technologies have been languish-

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[230] *See* Press Release, Federal Trade Commission, *supra* note 218.

[231] *See* Concurring Statement of Commissioner Pamela Jones Harbour, In the Matter of Lockheed Martin Corporation, The Boeing Company, and United Launch Alliance, L.L.C. (Oct. 2006) (No. C-4188), *available at*. http://www.ftc.gov/os/caselist/0510165/0510165Harbour.pdf.

[232] *Id.*

[233] *Id.*

ing. Although NASA has repeatedly failed to realize "cost effective designs for cheap, reusable space transportation" via its "megalithic" development programs, the New Space "laissez-faire" approach to developing commercial space transportation systems has not faired any better—nor will it in the future. This is because the free market development of these systems is stymied by a combination of factors, including the:

1. Uncertain and inelastic demand for the CST markets projected by the New Space industry (including space tourism);[234]

2. High investment risk in unproven technologies and systems;[235]

3. Large amounts of capital required to develop the requisite technologies for—and build—reusable space launch systems that are safe and reliable;[236] and

4. Present-day "laissez-faire" regulatory approach to space flight vehicle and passenger safety standards. Space flight vehicle safety and reliability should be evaluated against government-certified design, operational, manufacturing, flight testing, and regulatory (i.e., airworthiness and operating procedures) standards—NOT informing space flight participants (i.e., passengers), in writing, that the vehicle they wish to fly aboard is not government-certified as safe for carriage of persons.

Add to this mix the government-sponsored LAF-boycott, whose only incentive is to perpetually exploit their 1950's-based expendable launch vehicle technologies at taxpayer expense—rather than innovate—and the barriers to entry for nascent, small aerospace entrepreneurs become insurmountable.[237] As

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234 *See* Miller & Foust, *supra* note 183.

235 *Id.*

236 *Id.*

237 Recall, *supra* note 160, the Boeing VP's comment about making the *Space Shuttle* "the B-52 of space." Boeing's policy back then, as it still is today, was to also wring every last penny of profit from its antiquated family of expendable launch vehicles. After all, ELV's are a fully amortized cash cow; and with government-provided, cost-plus launch services contracts, how can Boeing ever lose when there is absolutely no risk? As mem-

previously stated, *supra*, "a federal, taxpayer supported bureaucracy will be particularly resistant to giving up its monopoly unless forced to do so."[238]

Clearly, neither NASA's "megalithic" development programs nor the New Space "laissez-faire" approach to developing commercial space transportation systems work because neither approach will "build an industry."[239] Successful transportation industries are built upon a solid foundation of technology and regulation, as the U.S. aviation industry was. Aerospace vehicles[240] are the key to realizing safe, reliable point-to-point space transportation and will, therefore, require an empirically-proven development paradigm to make New Space market dreams a reality.[241]

i. Technology-Based Standards Needed

Technology-based standards are crucial elements of a viable business case for the development of commercially owned and operated aerospace vehicles. Standards also provide a basis for obtaining the requisite flightworthiness approval from the governing regulatory authority. The technology-based standards required for aerospace vehicles will fall into three fundamental tiers of safety:

bers of the antitrust-proof United Space Alliance (USA) monopoly for operating the *Space Shuttle* (and its successor, the Ares expendable launch vehicle); and the United Launch Alliance (ULA) monopoly for operating EELVs, Boeing and Lockheed Martin have the U.S. launch market pretty much to themselves. As things stand today, how can small aerospace start-up firms compete against such a formidable government bureaucracy for investment capital?

[238] *See supra* note 201.

[239] *See* Miller & Foust, *supra* note 183.

[240] *See supra* note 4 for the definition of "Aerospace Vehicle."

[241] Recall, *supra* note 5, that point-to-point space transportation includes travel between two different locations on Earth, between the Earth and Earth orbits, and in Earth orbits.

1. Standards that address preventing failures;[242]
2. Standards that enable safe recovery of an aerospace vehicle in the event that a failure occurs, or multiple failures occur;[243] and,
3. Standards that minimize collateral damage, including saving lives, in the event an aerospace vehicle can no longer be operated safely.[244]

These safety standards should drive the development of AV-enabling technologies; and address the key AV-unique issues associated with point-to-point commercial space transportation (listed in Table 3, *infra*).

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[242] For example, structures are required to have sufficient margins so that the AV structure will not fail under normal conditions, or even more stressful operating conditions that may be encountered during abort situations. Other standards in this tier include the use of proven materials and construction methods; demonstrating the operating capability of systems and equipment in their expected operating environments; structural margins in load-bearing systems, such as landing gear and control system; and maintenance procedures to return the AV to flightworthy status.

[243] For example, for safety-critical systems such as hydraulics, redundancy is required so that if one hydraulic system fails the remaining hydraulic systems can be used to safely operate and land the AV. Other standards in this tier include performance margins to allow continued flight after an engine failure; firewalls and fire suppression equipment; and safety equipment such as supplemental oxygen in the event that the cabin experiences decompression.

[244] Design standards in this tier include crash protection, egress equipment and systems, emergency locator transmitters, and limiting hazardous operations to unpopulated areas.

• Atmospheric Conditions	• Remotely Operated AVs
• Cryogenic Propellants	• Venting
• Staging	• Outgassing
• Micrometeoroids and Orbital Debris Damage	• Radiation
• Solar Heating	• Atomic Oxygen
• Microgravity	• Deorbit
• Hazardous Materials	• Reentry
• Fuel Reserves	• Engine Inoperative Capability
• Balked Landings and Missed Approaches	• Noise: Take-off and Sonic Boom
• Powered-Lift (Vertical Take-off & Landing)	• AV Powerplants
• Fatigue Evaluation	

Table 3: Key AV-unique issues associated with point-to-point CST.

The U.S. Military pioneered the use of standards, specifications, and integrated integrity processes for commercial aviation that can readily be applied to aerospace vehicles. As previously discussed, *supra*, these standards and specifications were developed by joint government-industry committees; contractually implemented broadly within the U.S. aerospace industry; and transitioned into general industrial standards and specifications.[245] Hence, the successful development and regulation of passenger-carrying AVs should draw upon the successful design and operational heritage of these military and commercial aircraft systems.[246] The successful development of aerospace vehi-

[245] *See also* James Snead, *Achieving Near-term, Aircraft-like Reusable Space Access,* American Institute of Aeronautics and Astronautics, *available at* http://mikesnead.net/resources/spacefaring/tech_paper_achieving_near-term_aircraft-like_reusable_space_access.pdf (last visited June 24, 2008).

[246] As a starting point, a system safety functional hazard analysis (FHA) based process for analyzing passenger-carrying AVs should be defined to establish a generic set of safety design and operational standards. FHAs performed in the commercial jet aircraft industry, using SAE Aerospace Recommended Practices (ARP), should form the basis for the assessment process. The current military aircraft systems integrity processes should

cles will also depend upon the effective use of IP tools for navigating the patent thickets created by the government-sponsored LAF-boycott.

ii. Navigating the Patent Thickets

The need to navigate the LAF-boycott-created patent thickets and "hold-ups" is especially pronounced in the case of aerospace vehicle technology development, where underlying flight passenger and crew safety standards must be considered. Needless to say, cross licenses and patent pools are two natural and effective methods small aerospace firms can use to cut through patent thickets. Fortunately, these methods can be combined within a standard-setting environment to overcome antitrust concerns, as discussed in *Manufacturers Aerospace Vehicle Association, infra*. Of course, cross licenses and patent pools among the small aerospace firms, by themselves, are not enough to overcome the LAF-boycott without additional assistance; also discussed, *infra*.

a. Cross Licensing

Cross licenses can be negotiated between two small aerospace firms when each has patents that may read on the other's products or processes, rather than blocking each other and going to court or ceasing production.[247] In the case of a royalty-free cross license, each firm is then free to compete in the design and pricing of its products without fear of infringement or the burden of a per-unit royalty due to the other, respectively.[248] In this way, cross licenses can solve the complements problem among multiple small aerospace firms while still allowing them to be highly pro-competitive.[249]

Cross licenses, however, may or may not involve fixed fees or running royalties. Although running royalties—which may

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also be used to guide the development of AV standards that will lead to flightworthy AV systems.

[247] Shapiro, *supra* note 190, at 127.

[248] *Id*.

[249] *Id*.

run in one direction or both—could be used as a device to elevate prices and effectuate a cartel, such concerns would not apply to licenses that involved small or no running royalties; but rather had fixed, up-front payments.[250] Another concern is that granting licenses to future patents could reduce each firm's incentive to innovate because its rival may choose to only imitate its improvements rather than create new ones in return.[251] However, this concern is easily offset by the benefits realized through the enhanced design freedom each firm enjoys by virtue of its access to the other firm's patent portfolio.[252]

b. *Patent Pooling*

When one or more firms control patents necessary to manufacture a given product, and there are other manufacturers (actual or potential) of the same product without such patents, a patent pool or a package license can usually resolve the complements problem.[253] Within a patent pool, an entire group of patents is licensed in a package—either by one of the patent holders or by a new juridical entity established for this purpose—to another entity willing to pay the associated royalties.[254] On the other hand, a package license involves two or more patent holders who agree to jointly license their complementary patents and divide up the proceeds.

As previously discussed, *supra*, a good template for an historic patent pool is the Manufacturers Aircraft Association (MAA), formed in 1917, to license critical patents involving the production of aircraft. However, in the MAA case, a compulsory cross license was forced upon the predominant patent holders—Wright-Martin Aircraft Corporation and the Curtiss Aeroplane & Motor Corporation—by the Federal Government.

Today, the Department of Justice (DOJ) policy towards patent pools and package licensing vehicles has been clearly articulated in a trio of business review letters regarding an MPEG

[250] *Id*. at 130.
[251] *Id*.
[252] *Id*.
[253] *Id*. at 127.
[254] *Id*.

patent pool[255] and two DVD patent pools.[256] The essence of the DOJ policy is that inclusion of truly complementary patents in a patent pool is desirable and pro-competitive, whereas placing substitute or rival patents in a pool can eliminate competition and lead to elevated licensing fees.[257] In other words, the key distinction in forming a patent pool is that "blocking" or "essential" patents properly belong in a pool—"substitute" or "rival" patents probably do not, and may need to remain separate.[258]

c. Cooperative Standard Setting

Stated simply, "a standard is an agreed upon way of doing something."[259] Although standards exist in many forms, some common examples include, but are not limited to: video transmission and recordation formats; interchangeable automobile components; networking technologies and the protocols that enable them; electrical and other engineering codes; and FAA flight standards.[260] Furthermore, standards can be created through either formal or ad hoc processes, in one of three ways:

> (1) by market forces; (2) by exogenous forces; or (3) by coordinated efforts. Standardization by market forces is called a standard war or a de facto standard. Exogenous standards are those created by regulation, law, or other non-market forces. Coordinated standards are created when market participants

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[255] *See* Press Release, Department of Justice, Justice Department Approves Proposal for Joint Licensing of Patents Essential for Meeting Video Technology Standard Used in Electronics and Broadcast Industries (June 26, 1997), *available at* http://www.usdoj.gov/atr/public/press_releases/1997/1173.htm.

[256] *See* Press Release, Department of Justice, Justice Department Approves Joint Licensing of Patents Essential for Making DVD-Video and DVD-ROM Discs and Players (Dec. 17, 1998), *available at* http://www.usdoj.gov/atr/public/press_releases/1998/2120.htm. *See also* Press Release, Department of Justice, Justice Department Approves Joint Licensing of Patents Essential for Making DVD-Video and DVD-ROM Discs Players (June 10, 1999), *available at* http://www.usdoj.gov/opa/pr/1999/June/238at.htm.

[257] Shapiro, *supra* note 190, at 134.

[258] *Id.*

[259] Justin Hurwitz, *The Value of Patents in Industry Standards: Avoiding License Arbitrage with Voluntary Rules,* 36 AIPLA Q. J. 1, 6 (2008).

[260] *Id.* FAA flight standards generally include aircraft design, operational, manufacturing, flight testing, and regulatory (i.e., airworthiness and standard operating procedures) standards.

come together in an SSO for the purpose of creating a standard.[261]

Needless to say, these three distinct methods for creating standards are not as homogeneous as they appear; because different parties don't necessarily share the same market share, or market value expectations.[262]

Use of standards creates compatibility among products comprising systems, subsystems, and components in both vertical and horizontal arrangements.[263] In a vertical arrangement, standards allow each stage of production to operate independently of the other stages, enabling the output of one stage that meets a specific standard to be compatible with the input to another stage that meets the same standard.[264] Likewise, in a horizontal arrangement, compliance with standards allows disparate parties to interface through compatible interactions, thus eliminating otherwise duplicative efforts.[265]

On the other hand, standard setting very often embodies strong elements of both the complements problem and the "hold-up" problem.[266] Generally, SSO participants are reticent to agree to standards that can be controlled by any single entity through its patents.[267] Hence, standard setting organizations, like the American National Standards Institute (ANSI), typically require their participants to agree to license all patents essential to complying with a particular standard on "fair, reasonable, and non-discriminatory terms."[268] However, the terms of these licensing agreements are usually vague to avoid antitrust liability; as such agreements may be construed as "price fixing."[269] As a result, the very rules that are explicitly intended to resolve "hold up" problems—like ANSI's, *supra*—are rendered mute because vague licensing terms can lead to *ex post* "hold up" by

[261] *Id.* at 9.
[262] *Id.* at 10.
[263] *Id.* at 7.
[264] *Id.*
[265] *Id.*
[266] Shapiro, *supra* note 190, at 128.
[267] *Id*.
[268] Thus, resolving the complements problem. *See* Shapiro, *supra* note 190, at 128.
[269] *Id.*

certain patent rights holders; which is contrary to the goal of enabling innovation.[270]

iii. Collective Development Strategy

The modern cross licensing, patent pooling and government-led cooperative standard setting doctrines—discussed, *supra*—in concert with NACA-like, government-sponsored R&D, could be used by the New Space industry to collectively develop commercial aerospace vehicle enabling technologies and flight-worthiness standards for both suborbital and orbital vehicles. These doctrines, as part of an alternative strategy to the one presently employed by the New Space CST industry, could be implemented within the purview of the following five elements:[271]

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[270] *Id*. In fact, a number of disputes have surfaced that illustrate the *ex post* "hold up" problems associated with "hidden" patent rights that were later exerted against established standards. The leading U.S. example is the FTC's consent agreement with Dell Computer Corporation, announced in November 1995. Because Dell worked to have a technology it allegedly knew was proprietary—the VL-bus—adopted as a group standard, the FTC argued that Dell effectively sought to enlist its competitors in establishing a standard that it ultimately would be able to control. Dell agreed in the consent decree not to assert its IP rights in the VL-bus. *See id.* at 141. *See also* Press Release, Federal Trade Commission, Dell Computer Settles FTC Charges; Won't Enforce Patent Rights for Widely Used Computer Feature (Nov. 2, 1995), *available at* http://www.ftc.gov/opa/1995/11/dell.shtm. In a more recent example, the FTC charged Rambus, Inc., with violating federal antitrust laws by deliberately engaging in a pattern of anticompetitve acts to deceive an industry-wide standard-setting organization. The complaint alleged that Rambus participated in the Joint Electron Device Engineering Council (JEDEC), a standard-setting organization that "maintained a commitment to avoid, where possible, the incorporation of patented technologies into its published standards, or at a minimum to ensure that such technologies, if incorporated, will be available to be licensed on royalty-free or otherwise reasonable and non-discriminatory terms." Nonetheless, Rambus participated in JEDEC's DRAM standard-setting activities for more than four years without disclosing to JEDEC or its members that it was actively working to develop, and in fact possessed, a patent and several pending patent applications that involved specific technologies ultimately adopted in the standards. In its liability opinion dated July 31, 2006, the FTC found that "Rambus engaged in exclusionary conduct that significantly contributed to its acquisition of monopoly power in four related markets." *See* Press Release, Federal Trade Commission, FTC Issues Final Opinion and Order in Rambus Matter (Feb. 5, 2007), *available at* http://www.ftc.gov/opa/2007/02/070502rambus.shtm. However, the Commission lost this case on appeal.

[271] Although elements "3" and "4" are broken out separately, here; they are, in reality, interdependent and therefore discussed together in Section II.C.3. Collective Development Strategy, *infra*.

1. Formation of an IP-sharing, patent pool / standard setting organization;[272]
2. NACA-like, government-sponsored R&D for aerospace vehicle technologies;[273]
3. Government-led development of aerospace vehicle flightworthiness standards;
4. FAA certification of suborbital and orbital aerospace vehicles transporting passengers and cargo; and,
5. NASA contracts to private companies using aerospace vehicles for transporting passengers and cargo to low earth orbit.[274]

These five elements, graphically depicted in Figure 6, *infra*, are essential to evolving the AV systems integrity and airworthiness process necessary for next generation AV operations that are commercially viable.

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[272] The patent pool/SSO would be formed along the lines of the former Manufacturers Aircraft Association (MAA), only with voluntary cross licensing. Furthermore, all of NASA's intellectual property would be made available to members of the patent pool/SSO (may require an Act of Congress).

[273] This element will require an Act of Congress. As the successor agency to the original NACA, NASA may be the logical choice for this function; however, an outside, scientific agency or organization is probably a better choice.

[274] This element will also require an Act of Congress, and depend on the successful implementation of NASA's Vision for Space Exploration (VSE) program. The primary goal of the VSE program is to establish a permanent lunar base, in preparation for human exploration of Mars and other destinations. Transporting cargo and passengers to a lunar base creates the basis for a "point-to-point" space transportation market. Commercial, orbital-capable aerospace vehicles could provide the first leg of an earth-to-lunar space transportation system. *See* NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, THE VISION FOR SPACE EXPLORATION (2004), *available at* www1.nasa.gov/pdf/55583main_vision_space_exploration2.pdf.

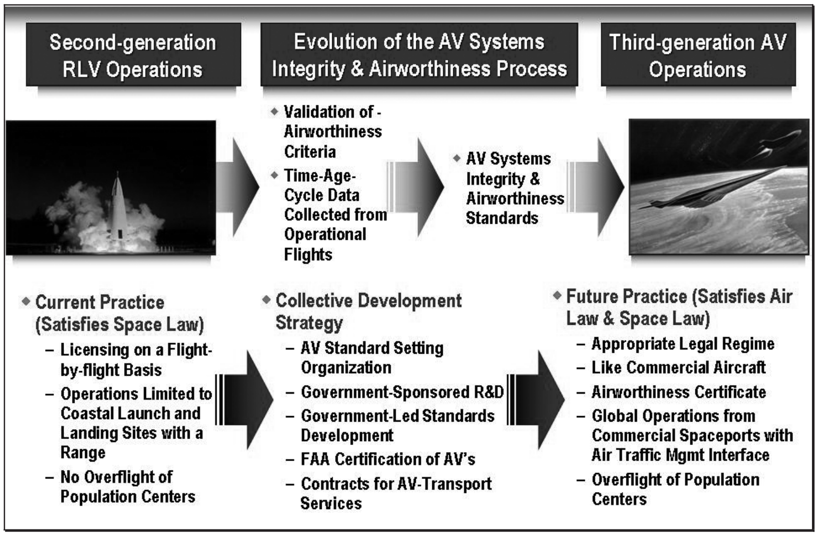

Figure 6: Evolution of the AV systems integrity & airworthiness process.

Fortunately, the NACA paradigm established a precedent for applying modern-day cross licensing, patent pooling, and standard-setting tools within the commercial space transportation industry. Indeed, small aerospace firms could use these tools to cut through a patent thicket's dense web of overlapping intellectual property rights—within the purview of a standard-setting organization—thus opening an avenue for commercializing their new technologies.

a. Manufacturers Aerospace Vehicle Association

As previously discussed, *supra,* a "'patent pool' is an agreement between two or more patent owners to license one or more of their patents to one another or third parties:"[275]

> Historically, to protect the public good, governments have created collective rights organizations: mandating compulsory licensing of patents at established fees, creating and managing

[275] *See* Nathan Modell, *Swallow the pill and jump in the patent pool* (2003), *available at* http://www.kent.ac.uk/law/ip/resources/ip_dissertations/2002-03/nrm2dissertation.doc.

> public patent pools, directly purchasing key enabling technology patents and placing them into the public domain, and even creating mergers between firms. Private institutions or industry-led consortia have also organized private patent pools including small contract-based patent pools, large industry-wide patent pools, and technology standard-setting pools.[276]

Small aerospace firms, then, as a first step, should collectively establish an AV technology development, standard-setting patent pool that is organized along the lines of the former Manufacturers Aircraft Association. In fact, this new SSO could be called the *Manufacturers Aerospace Vehicle Association* (hereinafter "MAVA").

(1) Antitrust Considerations

Recently, the Department of Justice and the Federal Trade Commission have recognized that patent pools can have significant pro-competitive effects, and may also improve a business' ability to survive this era of rapid technological innovation in a global market. *The Antitrust Guidelines for the Licensing of Intellectual Property* (hereinafter "IP Guidelines") recognize that "[l]icensing, cross-licensing, or otherwise transferring intellectual property . . . can facilitate integration of the licensed property with complementary factors of production."[277] In fact, such integration can "benefit consumers through the reduction of costs and the introduction of new products."[278] Specifically, the IP Guidelines state that intellectual property pooling is pro-competitive when it:

1. Integrates complementary technologies;

2. Reduces transaction costs;

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[276] *See* CPTech's Page on Collective Management of IP Rights: Patent Pool, available *at* http://www.cptech.org/cm/patentpool.html (last visited on June 24, 2008) (hereinafter CPTech's Page).

[277] DEP'T. OF JUST. AND FED. TRADE COMM'N, ANTITRUST GUIDELINES FOR THE LICENSING OF INTELLECTUAL PROPERTY § 2.3 (Apr. 6, 1995), *available at* http://www.ftc.gov/bc/0558.pdf (hereinafter IP Guidelines).

[278] *Id.*

3. Clears blocking positions;
4. Avoids costly infringement litigation; and,
5. Promotes the dissemination of technology.[279]

On the other hand, the IP Guidelines also state that excluding firms from an intellectual property pool may be anticompetitive if the:

1. Excluded firms cannot effectively compete in the relevant market for the product incorporating the licensed technologies;
2. Pool participants collectively possess market power in the relevant market; and,
3. Limitations on participation are not reasonably related to the efficient development and exploitation of the pooled technologies.[280]

The Justice Department has applied these guidelines when considering and approving a number of proposed patent pools. The first review of the IP Guidelines resulted in the following additional guidelines:

1. Patents in the pool must be valid and not expired;
2. No aggregation of competitive technologies and setting a single price for them;
3. An independent expert should be used to determine whether a patent is essential to complement technologies in the pool;
4. The pool agreement must not disadvantage competitors in downstream product markets; and
5. Pool participants must not collude on prices outside the scope of the pool, e.g., on downstream products.[281]

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[279] *Id.* § 5.5.
[280] *Id.*

Currently, the guidelines have been "collapsed" into the following two overarching questions: "(1) whether the proposed licensing program . . . is likely to integrate complementary patent rights[,] and (2) if so, whether the resulting competitive benefits are likely to be outweighed by the competitive harm posed by other aspects of the program."[282]

(2) Attributes

As discussed, *supra*, the events leading up to the NACA paradigm, and the evolution of the Manufacturers Aircraft Association; present venerable, on point precedents that highlight the contemporary concerns of the small aerospace firms vis-à-vis the government-sponsored LAF boycott. Furthermore, the Government's IP Guidelines recognize that transferring intellectual property can facilitate the integration of licensed property with complementary factors of production, and have evolved accordingly—something that is sorely needed by the fledgling commercial space transportation industry. Hence, as a first step, small aerospace firms should aggregate their patents into a pool within the MAVA standard setting organization.

The MAVA patent pool would, ideally, consist of all the currently available, "essential" AV-related technologies; both privately developed and government funded (in whole or in part).[283]

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[281] *See* MPEG-LA Letter from Joel I. Klein, Assistant Attorney General, Department of Justice, Antitrust Division, to Gerrard R. Beeney, Esq. (June 26, 1997), *available at* http://www.usdoj.gov/atr/public/busreview/215742.pdf.

[282] *See* Toshiba Review Letter from Joel Klein, Assistant Attorney General, Department of Justice, Antitrust Division, to Carey R. Ramos, Esq. (June 10, 1999), *available at* http://www.usdoj.gov/atr/public/busreview/2485.pdf.

[283] Recall, all of NASA's AV-related intellectual property would be made available to members of the patent pool/SSO, which may require an Act of Congress. *See supra* note 272. One way to ensure that the rights to all of the patents and know-how developed by the government-sponsored LAF boycott are acquired for the benefit of the pool is through the exercise of "march-in rights." Legislative action will, undoubtedly, be required to enforce the appropriate "march-in rights" trigger-clauses contained in the respective LAF-boycott members' cooperative agreements. Recall that the two most appropriate clauses were: (1) Such action is necessary because the Contractor or assignee has not taken, or is not expected to take within a reasonable time, effective steps to achieve practical application of the subject invention in such field of use; or (3) Such action is necessary to meet requirements for public use specified by Federal regulations and such requirements are not reasonably satisfied by the Contractor, assignee, or licensees. *See* Island One Society, *supra* note 178.

In addition, the pool would be administered independently of the aerospace companies, large or small, and closely linked to a non-partisan government agency. This independence would ensure that the patent pool and its administration remained immune to the politics and influence of the respective aerospace companies. The pool would also be voluntary, unlike the MAA example. On the other hand, the MAVA, like the MAA, would share the following attributes:

1. All pooled patents would be made available to each member of the pool;
2. Standard licensing terms would be offered to licensees who are not members of the pool;[284]
3. A fair and reasonable portion of the licensing fees would be allocated to each member of the pool according to a pre-set formula or procedure; and,
4. Licensing fees would be set by the members of the pool, in consultation with the committee (see *infra*).[285]

Ongoing adjustments to these attributes would be carried out via a permanent administrative structure, or committee similar in function to that of the MAA. The functions of this administrative structure would include, but not be limited to:

1. Remaining independent of government, political, and aerospace company influences;[286]
2. Determining which patents would be included in the patent pool, and in so doing, work closely with the FAA's aerospace vehicle certification and flight standards development ef-

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[284] These terms would be available to non-members via a coherent menu of prices and other terms to licenses.

[285] Rudi Bekkers et al., *Patent pools and non-assertion agreements: coordination mechanisms for multi-party IPR holders in standardization,* EASST 2006 Conference, Lausanne, Switzerland (2006).

[286] This is in contrast to the MAA, which had some committee members who were representatives of the member companies, allowing some influence on the valuations of the patents their respective companies owned.

forts[287] to ascertain which patents are AV-enabling and therefore "essential;"[288]

3. Managing the pool's patent portfolio—integrating new patents when they become available, and culling those that have been superseded;

4. Employing expert opinion to assign value to patents within the pool, and ensuring that patent owners receive reasonable royalty payments; and,

5. Setting reasonable royalty payments for using the pool's patents, and regulating the transaction process for licensing patents to third parties.[289]

And, like the Manufacturers Aircraft Association, membership in the MAVA would be open to three types of entities: (1) any "responsible" present or potential aircraft, aerospace vehicle or aerospace component manufacturer; (2) any manufacturer to which the Federal Government has awarded a contract for a single aircraft, spacecraft or space-qualified component; and (3) any owner of U.S. aircraft, spacecraft or space-related component patents.[290]

Another key provision needed by the MAVA to enable continual innovation is a "grant-back" clause, entered into by all

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[287] *See* Section II.C.3.c. *AV Standards & Certification, infra* p. 200.

[288] This function would include allowing the MAVA to buy third-party patents, which would permit association members to explore and develop an AV area without fear of patent infringement in cases where no individual firm had an incentive to purchase the relevant patent. Thus, third-party patent holders could sell their patents to an association member based on the "profit-maximizing" royalty, and then to others within the association based on the "most-favored-purchaser" clause. *See* Section II.A.1.a. *Economic Rationale*, *supra*. From an antitrust perspective, "most-favored-purchaser" clauses typically raise horizontal coordination concerns, particularly if they bare a resemblance to group boycotts. *See* Hurwitz, *supra* note 259, at 29. However, in Blue Cross & Blue Shield United of Wisc. v. Marshfield Clinic, 65 F.3d 1406, 1415 (7th Cir. 1995), the Court found that "['most-favored-purchaser'] clauses are standard devices by which buyers try to bargain for low prices, by getting the seller to agree to treat them as favorably as any of their other customers. . . . [T]hat is the sort of conduct that the antitrust laws seek to encourage." The proposed relationship between the MAVA and third-party patent holders is on point with this finding. *See* Hurwitz, *supra* note 259, at 29 n.94.

[289] *See* Modell, *supra* note 275.

[290] *Id*. *See also, supra* note 138.

members, which would ensure that any new patents and technologies developed by members or users of the patent pool are assigned back to the pool. In this way, the MAVA's technology development efforts will complement and provide synergy with the government-sponsored R&D program, discussed *infra*.

b. Government-Sponsored R&D

As previously discussed,[291] NACA, the precursor agency to NASA, was established by Congress as a rider to the Naval Appropriations Act of 1915 "to supervise and direct the scientific study of the problems of flight, with a view toward their practical solution."[292] Hence, NACA produced aeronautical technologies through basic and applied research that were transferred to its military and industry customers; thus creating the solid foundation of technology that today's aviation industry is built upon.[293] On the other hand, it has been shown that NASA's present-day "megalithic" development programs and the New Space "laissez-faire" approach to developing commercial space transportation systems cannot work because neither approach is geared toward building an industrial foundation of technology. Needless to say, an empirically-proven technology development paradigm—like NACA's—is needed to create the aerospace vehicles that will enable tomorrow's New Space CST-based markets.

Like the NACA program that preceded it, an aerospace vehicle technology transfer program, called the *National Advisory Committee on Aerospace Vehicles (NACAV)*, should be established by Congress as a federally funded and executed entity;[294] with a chief scientist or engineer, and an executive committee of interested government agency members leading the strategic

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[291] *See* Section II.A. *The NACA Paradigm*, *supra* p. 154.

[292] *See supra* note 122.

[293] The NACA lasted 43 years before this "experiment in government organization" was abandoned by President Eisenhower and the Congress in 1958 with the birth of NASA. *See* ROLAND, *supra* note 123, at 296.

[294] The NACAV should be linked to the same non-partisan government agency the MAVA is linked to.

direction of AV technology development.[295] Furthermore, a problem-oriented, industry representative-dominated, subcommittee forum within the NACAV should select specific projects that are close to the AV industry's interests, and produce results with immediate applications. Most importantly, however, NACAV research must not be mission-oriented, produce systems, or perform or lead any production efforts.[296] Rather, NACAV research must be "cut-and-try," involving systemic variation and engineering experimentation, and be broadly available via open publication and close contact with industry. The following summary "aptly [covers] the aims and purposes of the [NACAV]:"[297]

> [B]oth scientific discovery and its practical application are the products of long and arduous research. Discovery and invention do not spring full-grown from the brains of men. The labor of a host of men, great laboratories, long, patient, scientific experiment build up the structure of knowledge, not stone by stone, but particle by particle. This adding of fact to fact some day brings forth a revolutionary discovery, an illuminating hypothesis, a great generalization or practical invention.[298]

The NACAV's key research areas, as a start, could be selected from those listed in Table 1, and address the key AV-unique flightworthiness standards-related issues identified in Table 3, *supra*. Naturally, the NACAV executive committee would work closely with the MAVA administrative structure to patent and license the resulting "essential" technologies to MAVA members and interested third parties.

Although the NACAV executive committee must not comprise, or be led by, executives or program managers from either NASA or the aerospace industry,[299] NASA and industry engi-

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[295] The NACAV committee would include representatives from the MAVA and FAA's new *Directorate for Aerospace Vehicles* to ensure that essential AV technologies were developed to satisfy flightworthiness standards.

[296] *See The First Century of Flight*, *supra* note 122.

[297] *See* ROLAND, *supra* note 123, at 105.

[298] This quote was from a speech in 1931 by Herbert Hoover in praise of Thomas Edison. *See* ROLAND, *supra* note 123, at 105.

[299] This requirement includes "current or former" executives and program managers, and applies to the NACAV chief scientist or engineer position as well. It is extremely important that the NACAV remain politically and technically non-partisan.

neers and scientists at the subcommittee working level, as well as NASA facilities, should be employed to the greatest extent possible. The NACAV research process should be patterned after the one NACA employed, as follows:

> The research process . . . allowed for review of all NACA research when first proposed and at various intervals thereafter. Because the technical subcommittees evaluating and monitoring the research contained experts in the various branches of aeronautics, there was some guarantee that the subjects chosen for research were the best and most promising ones. Because the Executive Committee contained representatives of all the parties interested in aeronautical development (except industry), there was some guarantee that duplication was being avoided and that the NACA was not straying into someone else's territory.[300]

c. AV Standards & Certification

The certification of aerospace vehicles should be conceptually based upon the systems engineering approach evolved for the commercial aircraft industry. A key principle of this approach is that an AV design should be considered holistically, and not as the mere sum of its parts.[301] Another principle is that the design criteria for an AV and its subsystems should emanate from a logical set of performance requirements and operability attributes, and comply (at some level) with an appropriate set of standards for certification. These standards should then form the basis against which the system will be flight-tested.

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[300] *See* ROLAND, *supra* note 123, at 106.
[301] JACKSON, *supra* note 121, at 9.

• **Accidents Not Caused By:** – Flight Rules » *airspace problems, mid-air collision, right-of-way* – Operators » *highly trained, current, and qualified* » *no operator-caused accidents** – Operating Limits » *limits not intentionally violated*	• **Accidents Caused By:** – Demonstrable Flight Characteristics » *lack of envelope expansion flight test* – Design and Construction, Equipment and Systems » *material flaws in structure or equipment, non-redundant* – Structural Failure » *limit loads exceeded*
* With the exception of Challenger and Columbia	

Table 4: FAR guidelines applied to present-day launch vehicles.[302]

Table 4, *supra,* offers some insight into how flightworthiness standards will benefit aerospace vehicles. This table graphically illustrates the predominant failure modes of present-day launch vehicles when Federal Aviation Regulation (FAR) certification guidelines are applied. This would imply that FAR-qualified AVs will not fail routinely, and that an ample margin for recovery will exist should an anomaly occur. Naturally, the only way to certify the flightworthiness of aerospace vehicles is through extensive flight testing, and the collection of time-age-cycle data on AV subsystems, propulsion and structural components.[303]

Regulations and minimum standards relating to the manufacture, operation and maintenance of aircraft are resident in Title 14 of the U.S. Code of Federal Regulations, Chapter I, Parts 1 through 199 (14 CFR, Chapter I). These regulations and standards have their legacy in the Air Commerce Act of May 20, 1926, as amended by the Federal Aviation Act of 1958, and Public Law 103-272 in 1994—and have evolved considerably since the introduction of jet airliners. In fact, the Air Commerce Act

[302] Provided courtesy of Space Access, L.L.C.

[303] Flight-testing will be critical to the validation of "derived" AV flightworthiness standards, and the certification process. In addition to validating the requisite performance and operational capabilities of commercial AVs—including safety compliance—the second generation flight systems used for space tourism should be establishing the precedent for successfully operating in the present-day air and space legal regimes.

"was passed at the urging of the aviation industry, whose leaders believed the airplane could not reach its full potential without Federal action to improve and maintain safety standards."[304] Likewise, it would be in the aerospace vehicle industry's best interest for the FAA to begin formulating an aerospace vehicle certification process. The legal authority for formulating this process exists within the guidelines of FAR Part 1, Section 1.1, and Part 21 for aircraft.[305]

Figure 7, *infra*, depicts over a 70 year period, the running total number of missions successfully conducted by various air and space transportation systems since their last catastrophic failure. Needless to say, the many lessons learned from transport aircraft operations have, over the years, been incorporated in the FAA's airworthiness standards for transport aircraft. As a result, the reliability of transport aircraft is now approaching "one in ten million" catastrophic failures.

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[304] Federal Aviation Administration, *A Brief History of the Federal Aviation Administration*, *available at* http://www.faa.gov/about/history/brief_history/ (last modified Mar. 3, 2005).

[305] The FARs have evolved, since their inception, to accommodate the introduction of new aviation technologies. A classic example of this evolution was the three-phase certification process used to certify the airworthiness of the *Concorde* supersonic transport. "The first stage . . . included informal discussions in an attempt to agree on standards that would apply to both *Concorde* and to the U.S. SST [(supersonic transport)], and to agree on formal certification procedures . . . the second stage began with a conference . . . to discuss potential standards for commercial SSTs. The purpose of the meeting was to exchange views regarding noncompetitive information on airworthiness, system-worthiness, sonic boom, airport noise limitations, and operational factors. To start the third phase, the FAA worked to establish technical requirements that would have to be satisfied by a new SST . . . [and] transmitted to *Concorde* designers a list of 23 possible problem areas, including: cockpit view, emergency evacuation of passengers, runway length required, fuel reserves, noise abatement procedures, center-of-gravity control, controllability, crashworthiness, reliability of systems, new materials, structural loads, speed margins, de-icing, and ten specific propulsion items." HENRY R. HERTZFELD ET AL., THE GEORGE WASHINGTON UNIVERSITY SPACE POLICY INSTITUTE, DEVELOPING A STRATEGY FOR RLV CERTIFICATION: FINAL REPORT 58 (2001).

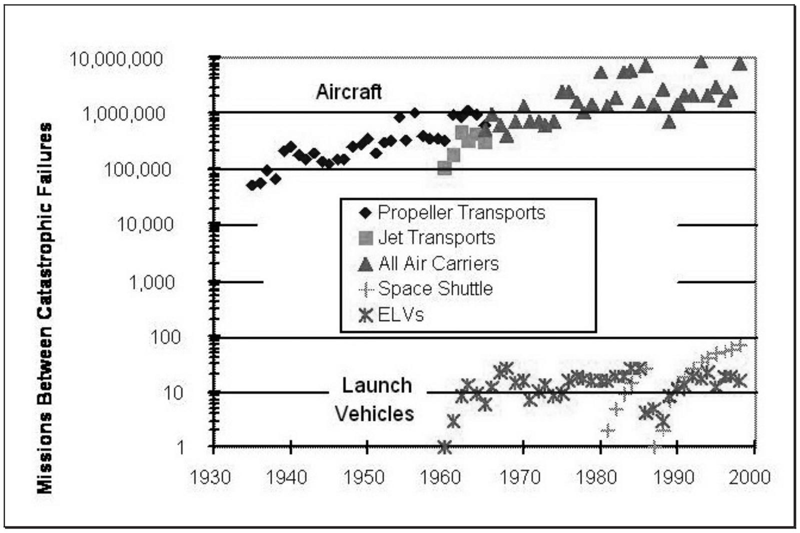

Figure 7: Missions between catastrophic failures for air and space transportation systems.[306]

Within the FAR Part 1 and Part 21 guidelines, the FAA should establish a *Directorate for Aerospace Vehicles*, patterned after the existing FAA Directorates (i.e., Transport Aircraft, Engine, Small Aircraft, and Helicopter). Staffed with dedicated "subject matter" experts, this new *Directorate* could work with the aerospace vehicle industry, through the MAVA, to formulate flightworthiness standards that complement existing FARs only to the extent necessary to regulate AVs. These FARs, 14 CFR 1 – 199, could be synthesized into a separate "FAR Part for Aerospace Vehicles" that addresses the major areas listed in Table 5, *infra*.

[306] Provided courtesy of Space Access, L.L.C.

• **AV Design and Maintenance Standards** – Demonstrable Flight Characteristics – Structural Capability – Manufacturing and Materials – Equipment and Systems – Operating Limits – Instructions for Continued Flightworthiness	• **Operations Requirements and Training** – Flight Operations – Ground Operations – Maintenance Operations – Personnel Training, Currency, Medical
• **Airspace Requirements** – Flight Rules – Air Traffic Control	• **Facilities and Ground System Requirements** – Mission Control – Maintenance – Support Equipment
• **Provisions for Recognizing New Technologies**	

Table 5: Major areas addressed by proposed FAR Part for AVs.

The standards and requirements of Table 5 should be defined with an eye toward how they will be employed in the design and verification of next generation, aerospace vehicle systems. Hence, the commercial AV development process should emphasize a methodology for integrating the systems engineering design and verification process with the certification process:

> The FAA, in cooperation with the Society of Automotive Engineers (SAE), has taken a major step towards incorporating [system engineering principles] into the certification process with the publication of ARP 4754 [*Certification Considerations for Highly-Integrated or Complex Aircraft Systems*] . . . it represents a look into the future of certification and demonstrates the FAA's and SAE's commitment to the [systems engineering] process.[307]

d. Contracts for AV-Transport Services

As previously stated, *supra*, although NACA was the predominant government agency supporting civil aircraft R&D, the Air Mail Service of the U.S. Post Office represented the largest

[307] JACKSON, *supra* note 121, at 41.

number of federal dollars directed toward the development of the commercial aviation market.[308] This was because of the Kelly Act, which empowered the Postmaster General of the United States to expand the domestic air route system by awarding contracts to fly specific airmail routes in a successful effort to streamline and rationalize the air transportation industry.[309] Also, under the Kelly Act, important aviation-related infrastructure was developed to spur private investment, and thus forge a national system of air transportation. Clearly, the Federal Government, in conjunction with private investors, invested in the development of commercial aviation because there was a market for going "somewhere to somewhere" on Earth. Although the Space Station provided the initial impetus for going "somewhere to somewhere" in space, it wasn't until the advent of the Vision for Space Exploration (VSE) that the first significant opportunity has manifested itself.

The overarching goal of the VSE program is to establish a permanent lunar base, in preparation for human exploration of Mars and other destinations.[310] To accomplish this vision, NASA is developing the *Space Shuttle*'s next generation replacement, the *Crew Exploration Vehicle* (*CEV*). The *CEV* design is, fundamentally, a throwback to the 1960's vintage *Apollo* moon launch system, except with a "reusable" capsule launched on top of an expendable in-line booster.[311] Furthermore, the *CEV* is part of NASA's Constellation Systems, which also comprises "In-Space Transportation Systems" such as the *Earth Departure Stage* (*EDS*) and *Lunar Surface Access Module* (*LSAM*).[312] Perhaps NASA's transportation architecture for space exploration is counterintuitive; but why would an agency design an architecture where the in-space systems are fully reusable and the Earth–to–low-Earth-orbit (LEO) system is not? Regardless of NASA's reasons, which are beyond the scope of this paper, it is

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308 *See* Douglas, *supra* note 8, at 154.
309 *See supra* note 9.
310 *See supra* note 274.
311 *See supra* note 159.
312 *See* About.com: Space/Astronomy, *Constellation Systems*, *at* http://space.about.com/od/nasanewscurrentevents/a/cevsystem.htm?p=1 (last visited June 29, 2008).

intuitively obvious that once a permanent lunar base is established, the *CEV*'s launch costs using in-line expendable launch vehicles are going to become untenable.[313]

On the other hand, the ideal fully reusable Earth/Lunar space transportation architecture would employ a next generation aerospace vehicle—a fully reusable, two-stage-to-LEO system capable of lifting 35,000 lbs. for less than \$25M per launch.[314] With launch costs down to less than \$725 per *payload* pound, limited financial resources that ordinarily would have been wasted on expensive, expendable hardware (\$10K+ per *payload* pound) could now be leveraged into the development and production of the reusable in-space systems necessary for sustaining permanent lunar settlements. In addition, the AV would have a turn-around time of three days, which would allow the rapid deployment, re-supply, and expansion of NASA's first lunar base.

Assuming that the first four elements of the *Collective Development Strategy*, discussed *supra*, are successfully implemented in the near term, there is a good possibility that a small, *DC-3* type aerospace vehicle could be ferrying astronauts (or at least 5 thousand pounds of cargo) to and from the Space Station within a reasonable time period.[315] And, like the *DC-3*, this small AV could revolutionize space transportation and pave the way for larger, more advanced (and economically efficient) space

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[313] This is analogous to throwing away a brand new *Boeing 747* freighter after it makes its first and only cargo delivery. Multiply this scenario by at least four times per year, and the losses begin to add up.

[314] Fundamentally, the \$25 million would be the cost of the propellants, routine maintenance, and amortization of AV development costs; because the AV would be fully reusable. These figures are based on a study performed by the author as part of his Masters program in Space Studies. *See* H.A.M.L.E.T. Earth/Lunar Space Transportation System (1998) (unpublished graduate Space Studies Capstone Project course final report, University of North Dakota) (on file with the University of North Dakota Department of Space Studies).

[315] The *Douglas DC-3* is an American fixed-wing, propeller-driven aircraft whose speed and range revolutionized air transport in the 1930s and 1940s. Because of its lasting impact on the airline industry and World War II, it is generally regarded as one of the most significant transport aircraft ever made. *See* WIKIPEDIA, *Douglas DC-3, at* http://en.wikipedia.org/wiki/Douglas_DC-3 (last modified on June 24, 2008). U.S. Centennial Flight Commission, The Douglas *DC-3*, http://www.centennialofflight.gov/essay/Aerospace/DC-3/Aero29.htm (last visited June 25, 2009).

transports capable of providing the first leg (Earth–to–LEO) of an Earth-to-lunar space transportation system.

However, implementation of the fifth and final element of this *Strategy*—NASA contract guarantees for AV transport services—is absolutely necessary. Just as the Kelly Act was the final step for enabling the commercial aviation industry, so must the Federal Government, once again, step up with an equivalent *Space Act* to enable the AV industry.

III. CONCLUSION

The foregoing analysis has shown that neither NASA's "megalithic" development programs nor the New Space "laissez-faire" approach to developing commercial space transportation systems work because neither approach will "build an industry." Successful transportation industries "for the masses" are built upon a solid foundation of technology and regulation, as the U.S. aviation industry was. Aerospace vehicles are the key to realizing safe, reliable point-to-point space transportation and will, therefore, require an empirically-proven development paradigm to make New Space market dreams a reality.

Modern cross licensing, patent pooling and government-led cooperative standard setting doctrines, in concert with NACA-like, government-sponsored R&D, could be used by the New Space industry to collectively develop commercial aerospace vehicle enabling technologies and flightworthiness standards for both suborbital and orbital vehicles. These doctrines, as part of an alternative strategy to the one presently employed by the New Space CST industry, could be implemented within the purview of the following elements:

1. Formation of an IP-sharing, patent pool / standard setting organization;

2. NACA-like, government-sponsored R&D for aerospace vehicle technologies;

3. Government-led development of aerospace vehicle flightworthiness standards;

4. FAA certification of suborbital and orbital aerospace vehicles transporting passengers and cargo; and,

5. NASA contracts to private companies using aerospace vehicles for transporting passengers and cargo to low earth orbit.

The successful implementation of these five elements in the near term could easily lead to the development of a small, *DC-3* type aerospace vehicle capable of ferrying astronauts (or at least 5 thousand pounds of cargo) to and from the Space Station within a reasonable time period. And, like the *DC-3*, this small AV could be the forerunner of future systems providing routine access to space that is truly affordable and reliable—not just for the wealthy, but for the masses.

THE DUTY TO RESCUE SPACE TOURISTS AND RETURN PRIVATE SPACECRAFT

Mark J. Sundahl[*]

I. INTRODUCTION

In late 2010, a long-awaited moment in the history of space flight will finally arrive when private space tourism companies send their first customers into space. Virgin Galactic, the space tourism company launched by Sir Richard Branson, will be the first to begin operations by flying tourists into suborbital space from Spaceport America, which is currently under construction in New Mexico.[1] Other space tourism companies will be entering the market soon thereafter. As the prospect of a space tourism industry becomes a reality, various legal issues are taking on a new urgency. This article addresses one of the more important issues from the perspective of a space tourism company, namely, whether the duty to rescue astronauts and return spacecraft under existing space law treaties also requires states to rescue space tourists and return the spacecraft to the launching state following an accident.

Virgin Galactic's customers will not be the first space tourists. In 2001 the Russian Space Agency began to fly tourists to the *International Space Station* – a trip which has recently gone up in price from $20 million to $30 million – and has to date sent a total of six tourists to the space station without complica-

[*] Associate Professor of Law, Cleveland State University, Cleveland-Marshall College of Law. This Article stems from an earlier paper entitled *Rescuing Space Tourists: A Humanitarian Duty and Business Need*, which the author presented at the 2007 International Astronautical Congress and which appeared in the conference proceedings. *See* Mark J. Sundahl, *Rescuing Space Tourists: A Humanitarian Duty and Business Need*, *in* PROCEEDINGS OF THE FIFTIETH COLLOQUIUM ON THE LAW OF OUTER SPACE 204 (2008). This Article expands considerably on the material contained in the earlier paper and incorporates comments from the conference panelists and other reviewers. The author would like to thank his fellow panelists at the 2007 IAC, and in particular Prof. Francis Lyall, for their helpful comments.

[1] Jeff Jones, *Bill Would Prevent Space Tourist Lawsuits*, ALBUQUERQUE J., A2 (Feb. 10, 2009).

tion.[2] Now private companies are preparing to do what only governments have done before and will be doing it on a far grander scale. The number of space tourists will climb into the hundreds within the next few years and, if the business model succeeds, Virgin Galactic predicts that the number will soon reach into the thousands as daily flights leave out of Spaceport America and other facilities around the world. And Virgin Galactic is not the only name in space tourism. Excalibur Almaz, a company based on the Isle of Man, plans to put tourists into orbit in Soviet-made *Almaz* space capsules.[3] The company is also preparing to use an *Almaz* space station as the first space hotel. Space stations that could be used as orbiting hotels are also being built by Bigelow Aerospace, which is headquartered in Las Vegas.[4] Bigelow's *Genesis* space station is an inflatable orbiting platform that can house scientific, manufacturing, or leisure activities, depending on the needs of the client.[5] Other space tourism companies are also taking shape – such as Rocketplane, which plans to launch suborbital flights out of Dubai, Xcor Aerospace, which is offering suborbital flights for a competitive price of $95,000, and Blue Origin, a highly secretive space tour-

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[2] The six tourists who have visited the *International Space Station* are Dennis Tito, Mark Shuttleworth, Gregory Olsen, Anousheh Ansari, Charles Simonyi, and Richard Garriott. Erin Killian, *Next space tourist starts training in Russia*, WASH. BUS. J. (Jan. 21, 2008). The flights to the *International Space Station* have been booked through a private company, Space Adventures, Ltd. *Id*. However, the Russian Space Agency announced in January of 2009 that it would be suspending its tourism operations due to the need for an expanded Russian crew on the space station. *Russia Grounds Space Tourism: International station will be too full for civilians after 2009*, CHI. TRIB. 21 (Jan. 26, 2009). Space tourism could be said to have truly begun in 1990 when Toyohiro Akiyama, a Japanese journalist who spent almost eight days on the Russian space station, Mir, became the first private person to go into space. MANNED SPACE FLIGHT: LEGAL ASPECTS IN THE LIGHT OF SCIENTIFIC AND TECHNICAL DEVELOPMENTS 168 (Karl-Heinz Böckstiegel ed., 1993) (hereinafter MANNED SPACE FLIGHT). Other private individuals who have flown aboard the Space Shuttle include Senators John Glenn and Jake Garn – as well as a schoolteacher from Concord, New Hampshire, Christa McAuliffe. *Tourist Class: Tito had fun, but NASA still has a point*, COLUMBUS DISPATCH 6A (May 8, 2001).

[3] Stephen Baird, *Space: The New Frontier!*, TECH. TCHR. 13 (April 1, 2008).

[4] Frank Morring, Jr., *High Mileage*, AVIATION WK. & SPACE TECH. 21 (May 19, 2008).

[5] *Id*.

ism company owned by Jeff Bezos, the founder of Amazon.[6] Another Internet mogul, PayPal-founder and high-tech visionary Elon Musk, has also positioned himself on the cutting edge of commercial space by creating a new type of rocket that can deliver payloads – and eventually people – into space in a highly efficient and cost-effective manner.[7]

As the private space industry evolves in these new and exciting ways, it is beginning to outgrow the existing space law regime that was created at the advent of the space age – when only governments had a presence in space and the private use of space was a distant dream. Of the many legal issues that have emerged with respect to space tourism, one of the most critical issues is whether the duty to rescue astronauts and return errant spacecraft will apply to space tourism ventures. As tourism companies prepare to launch their maiden flights, their primary concern will be the safety of their customers and ability to recover their spacecraft. A steady flow of customers will be essential to the success of the tourism business model and this flow will only be possible if the public views the flights as safe. Safe operations will also reduce the risk that a space tourism company will be subjected to the crushing liability that would follow an accident. Moreover, since all of the space tourism companies plan to use reusable spacecraft to some degree, they will want to provide for the recovery of their spacecraft in the event of a flight anomaly.[8] In addition to the issue of whether the treaties apply to tourists, clarity is also lacking with respect to other aspects of the duty to rescue – such as whether there is a duty to rescue astronauts stranded in orbit.[9] The United Na-

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[6] Jacqui Goddard, *Up, Up And Ka-Ching! In a Time of Tight Budgets and Earthly Priorities, the Space Business is Getting a Rejuvenating Jolt from Entrepreneurs Who Do the Right Stuff on the Cheap*, NEWSWEEK (Feb. 11, 2008).

[7] In December of 2008, Musk's company, SpaceX, along with another private company, Orbital Sciences, was awarded a $3.5 billion contract by NASA to deliver cargo to the *International Space Station*. This contract was a watershed moment in the private space industry because NASA selected two newer companies over NASA's traditional launch service providers, Lockheed Martin and Boeing. Dana Hedgpeth, *Smaller Companies Win NASA's Space Race*, WASH. POST, at D1 (Dec. 24, 2008).

[8] Virgin Galactic and RocketPlane will use spaceplanes that take off and land horizontally, while *Excalibur Almaz* will send tourists into orbit in reusable space capsules.

[9] The gaps and ambiguities in the law of rescue has been traditionally viewed as a result of the hasty drafting process that produced the Agreement on the Rescue of As-

tions Committee on the Peaceful Use of Outer Space (UNCOPUOS) has been urged by member states on more than one occasion to try to resolve the flaws in this area of space law – but the issue has not yet been added to the UNCOPUOS agenda.[10]

This article seeks to clarify the extent to which space tourism companies can rely on states to assist with the rescue of space tourists and the return of their spacecraft in the event of an emergency. Unlike previous treatments of this subject, this article adopts an approach to treaty interpretation that rigorously adheres to the canons of interpretation set forth in the *Vienna Convention on the Law of Treaties* (the "Vienna Convention"). Section II of this article lays the groundwork for this analysis by describing the basic contours of the duty to rescue astronauts and return errant spacecraft under international law. Section III will then take up the fundamental questions regarding whether the duty to rescue applies to commercial ventures and whether tourists are beneficiaries of the duty to rescue. Finally, Section IV explores how the law of rescue and return should be reformed and what the best approach to reforming the law would be. Among other things, this discussion will take into account the proposals for reform set forth in the *Draft for a Convention on Manned Space Flight*, an illuminating (but surprisingly overlooked) document jointly drafted by Professors Böckstiegel, Gorove, and Vereshchetin some twenty years ago.

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tronauts, the Return of Astronauts and the Return of Objects Launched into Space. The urgency with which the treaty was drafted was due to the importance placed by the United States and the Soviet Union on the protection of its astronauts. References to the accelerated drafting process can be found throughout the comments of the delegates to the Meeting of the General Assembly when the treaty was opened for signature. See, *e.g.*, *Provisional Verbatim Record of the Sixteen Hundred and Fortieth Plenary Meeting*, U.N. GAOR, 22d Sess., at 36, 41, & 47, U.N. Doc. A/PV.1640 (Dec. 19, 1967) [hereinafter Provisional Verbatim Record]. In response to this criticism, the U.S. delegate, Mr. Goldberg, asserted that "it would be a mistake to assume that the draft had not been carefully prepared . . . [and that it] will stand the test of time." *Id.* at 56.

[10] In 1987, the United Kingdom and Czechoslovakia recommended that UNCOPUOS study the possibility of clarifying the law regarding the rescue of astronauts. See *Working Paper Submitted by The United Kingdom of Great Britain and Northern Ireland*, U.N. Doc. A/AC.105/C.2/L.159 (Mar. 27, 1987); *Working Paper Submitted by Czechoslovakia*, U.N. Doc. A/AC.105/C.2/O.161 (Apr. 2, 1987).

II. AN OVERVIEW OF THE DUTY TO RESCUE AND RETURN

This section describes the scope of the duty to rescue astronauts and return errant spacecraft as the duty has evolved through the drafting of three space treaties. This analysis will show how certain weaknesses in the original expression of the duty to rescue was cured by later treaties – and how other flaws emerged in the process. As will be seen, the duty to rescue and return is broad in its conception and is motivated by a concern for human welfare. Nevertheless, certain questions of interpretation remain regarding the precise scope of the duty to rescue – such as whether the treaties require the rescue of tourists. These outstanding issues will be presented at the close of this Section and then resolved in Section III through the application of the Vienna Convention.

A. The Duty to Rescue

Ideally, space law would impose a duty to rescue whenever anyone aboard a spacecraft experiences distress, whether on the ground, in space, or on a celestial body. However, as the following description of the duty to rescue under existing space law shows, the space treaties were drafted in a manner that creates uncertainty about whether the duty to rescue under the treaties reaches this ideal.

In 1968, the first space treaty, 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), was opened for signature.[11] This "Magna Carta" of space law set forth the basic principles that would guide the future use of space. Article V of the Outer Space Treaty created the foundation of the duty to rescue with broad brushstrokes that were animated by a humanitarian concern for the safety of astronauts.[12] Article V requires states to "regard astronauts as envoys of mankind" and to give astronauts "all

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

[12] *Id*. art. V.

possible assistance in the event of accident, distress, or emergency landing on the territory of another State Party or on the high seas."[13] The treaty also requires astronauts to provide "all possible assistance" to each other.[14] This duty for astronauts to assist each other has the advantage of being utterly unqualified – and therefore requires such assistance under any circumstances and in any location. Unfortunately, the duty of *States* to rescue astronauts is not quite as comprehensive. Although Article V appears to take a comprehensive approach to the duty to rescue, there are three limitations on the duty to rescue. First, rescue is only required when "possible" – which could refer to a state's technological or financial capability to engage in a rescue operation. Second, a careful parsing of Article V reveals a gap in the duty to rescue when astronauts have made an emergency landing, namely, that rescue is not required in the event of an emergency landing on Antarctica or on a celestial body since the duty to rescue is triggered by emergency landings only when the landing takes place "on the territory of another State Party or on the high seas."[15] Finally, the treaty only requires states to rescue "astronauts" – which raises the question whether states would be required to rescue non-crew members, such as passengers.

Just one year after the Outer Space Treaty was opened for signature, the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Space (Rescue Agreement) was concluded in order to elaborate upon the duty to rescue and return that had been established in Article V of the Outer Space Treaty.[16] The Rescue Agreement

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[13] *Id*. The language of Article V closely tracks the wording of Paragraph 9 of the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, G.A. Res. 1962 (XVIII), U.N. Doc. A/RES/1962 (Dec. 24, 1963), 3 I.L.M. 157.

[14] *Id*.

[15] Outer Space Treaty, *supra* note 11, at art. V. On the other hand, rescue of astronauts stranded in space would be covered under the language of Article V. *See*, *e.g.*, R. Cargill Hall, *Rescue and Return of Astronauts on Earth and in Outer Space*, 63 AM. J. INT'L L. 197, 205 (1969).

[16] Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, Apr. 22, 1968, 672 U.N.T.S. 119 [hereinafter Rescue Agreement].

addresses the rescue of spacecraft personnel in two provisions. Article 2 addresses "unintended landings" of spacecraft personnel in a state's territory and requires that the state "immediately take all possible steps to rescue them."[17] Article 3 complements Article 2 by addressing accidents that occur outside of any state's jurisdiction and provides that if a state discovers that "the personnel of a spacecraft have alighted on the high seas or in any other place not under the jurisdiction of any State, those Contracting Parties which are in a position to do so shall, if necessary, extend assistance in search and rescue operations."[18] These two provisions, working together, would appear to provide for rescue wherever a spacecraft experiences distress. The gap in Article V of the Outer Space Treaty that excludes crash landings on Antarctica or a celestial body is corrected by the Rescue Agreement since rescue is required under Article 3 if a spacecraft alights "any other place not under the jurisdiction of any State" (which would include parts of Antarctica as well as a celestial body).[19] However, despite the fact that the Rescue Agreement fills a gap in the Outer Space Treaty, it opens a new gap at the same time by using the word "alighted" in Article 3. The effect of this word is to make the duty to rescue contingent on the landing of the spacecraft – which, as a result, appears to rule out any duty to rescue personnel stranded in orbit or in deep space.[20] Finally, Article 4 of the Rescue Agreement requires states to "safely and promptly" re-

[17] *Id*. at art. 2.

[18] *Id*. at art. 3.

[19] *Id*. *See also* CARL Q. CHRISTOL, THE MODERN INTERNATIONAL LAW OF OUTER SPACE 171-72 (1982) (explaining that a U.S. delegate to the Rescue Agreement negotiations understood "any other place not under the jurisdiction of any State" to include the moon and celestial bodies."). Regarding jurisdictional claims over Antarctica see Joseph J. Ward, *Black Gold in a White Wilderness--Antarctic Oil: The Past, Present, and Potential of a Region in Need of Sovereign Environmental Stewardship*, 13 J. LAND USE & ENVTL. L. 363, 367 (1998) (explaining that fifteen percent of Antarctica is not claimed by any country).

[20] CHRISTOL, *supra* note 19, at 171-72; *see also* Paul G. Dembling & Daniel M. Arons, *The Treaty on Rescue and Return of Astronauts and Space Objects*, 9 WM. & MARY L. REV. 630, 649 (1968). This unfortunate gap in the Rescue Agreement created by the use of the word "alighted" could not have been intended, as is indicated by the comment of the French delegate, Mr. Berard, that the Rescue Agreement "applies to research and rescue undertaken not only on the earth and in its environment, but also in outer space and on celestial bodies." *Provisional Verbatim Record*, *supra* note 9, at 41.

turn the rescued personnel to representatives of the launching authority following a successful rescue operation.[21]

The duty to rescue was next addressed in the 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement).[22] The approach to the duty to rescue taken in the Moon Agreement was the most comprehensive of all the space treaties. First, the treaty requires states to take "all practicable measures to safeguard the life and health of persons on the moon."[23] There are no gaps in this language. All people, whether crewmembers, scientists, or tourists, must be safeguarded. Second, the Moon Agreement requires states to "offer shelter in their stations, installations, vehicles and other facilities to persons in distress on the moon" as well as allowing states to use the facilities of other States in the event of an emergency.[24] Finally, the Moon Agreement extends the duties owed to "astronauts" and "personnel" under the Outer Space Treaty and Rescue Agreement to all people on the Moon.[25]

Despite the admirable breadth of the rescue provisions in the Moon Agreement, the value of the treaty is compromised in two ways. First, it is restricted to the Moon and therefore is not applicable to the early stages of private spaceflight, which will be suborbital and orbital for the near term. Second – and more importantly – the Moon Agreement has been ratified by only thirteen states (compared to the Outer Space Treaty and the Rescue Agreement which have been ratified by ninety-eight states and ninety states, respectively), which renders it the least successful of the space treaties.[26]

As indicated above, the question of whether the duty to rescue applies to space tourists hinges on whether tourists qualify as "astronauts" or "personnel" of a spacecraft under the treaties.

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[21] Rescue Agreement, *supra* note 16, at art. 4.

[22] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 5, 1979, 1363 U.N.T.S. 3 [hereinafter Moon Agreement].

[23] *Id*. at art. 10(1).

[24] *Id*. at arts. 10(1) & 10(2).

[25] *Id*. at art. 13(2).

[26] *Status of International Agreements Relating to Activities in Outer Space*, U.N. Doc. ST/SPACE/11/Rev.2/Add.1 (Jan. 1, 2008).

Moreover, a preliminary question that is of equal importance to the application of the treaties to tourists is whether the duty to rescue extends to participants (whether crewmembers or passengers) of commercial spaceflights – or is instead strictly limited to state-sponsored missions. These issues will be analyzed further in Section III below after the duty to return errant spacecraft has been described.

B. The Duty to Return Errant Spacecraft

If a private spacecraft veers off course and lands in foreign territory, the owner of the spacecraft will want to be able to retrieve the spacecraft for reasons other than rescuing the passengers and crew. The risk of losing a spacecraft could be devastating to a space tourism company for two reasons. First, the cost of constructing a new vehicle may be prohibitive and, provided that the downed spacecraft is still functional or reparable, the cost of replacement could be avoided.[27] Second, any proprietary technology that falls into the hands of an unfriendly government could result in the theft of the technology – which might eventually be shared with a company's competitors. For both of these reasons, a company will want to quickly recover its errant spacecraft. However, a foreign government that has possession of the spacecraft may not want to part with it. For example, the foreign government may want to impound the spacecraft on the grounds that it violated the country's aircraft regulations. A foreign government may also have more nefarious reasons for refusing to return a high-tech spacecraft since an unintended landing may provide a rare opportunity for certain countries to gain access to exotic technology through reverse engineering. The space treaties provide for a duty to return spacecraft to the launching state in order to prevent such misappropriation of technology. It would provide great comfort to private space companies if they were assured that the benefits of this aspect of space law extended to their vehicles as well as to government spacecraft.

[27] Although insurance could potentially cover the cost of replacing a spacecraft, it is not clear whether such insurance will be available or affordable.

As is true for the duty to rescue, the duty to return space assets is contained in the Outer Space Treaty, the Rescue Agreement, and the Moon Agreement. Beginning with the Outer Space Treaty, Article VIII provides that "objects or component parts found beyond the limits of the State Party to the [Outer Space] Treaty on whose registry they are carried shall be returned to that State Party."[28] This provision is broadly drafted to require the return of space objects regardless of whether the errant objects are found on Earth, on the high seas, in space, or on a celestial body. Article 5 of the Rescue Agreement elaborates upon and expands this duty in several ways. First, Article 5 has a notification requirement which requires a state "which receives information or discovers that a space object or its component parts has returned to Earth in territory under its jurisdiction or on the high seas or in any other place not under the jurisdiction of any State" to notify the launching state and the Secretary-General of the United Nations.[29] Unlike the other provisions regarding the return of spacecraft, this notification language is drafted narrowly to require notification only when the space object has "returned to Earth," thus apparently releasing states from any duty to notify the launching authority if information is received, for example, that a spacecraft has gone adrift in space or has crashed on the Moon. Second, Article 5 requires a state on whose territory a spacecraft lands to "take such steps as it finds practicable to recover the object" upon the request of the launching state.[30] Third, if a State finds a space object or its component parts outside of the territory of

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[28] Outer Space Treaty, *supra* note 11, at art. VIII.

[29] Article 5(1) of the Rescue Agreement reads thus:

> Each Contracting Party which receives information or discovers that a space object or its component parts has returned to Earth in territory under its jurisdiction or on the high seas or in any other place not under the jurisdiction of any State, shall notify the launching authority and the Secretary- General of the United Nations.

Rescue Agreement, *supra* note 16, at art. 5(1). Although there is a notification requirement in Outer Space Treaty, it only requires states to inform other states of "any phenomenon . . . which could constitute a danger to the life or health of astronauts." Outer Space Treaty, *supra* note 11, at art. V. It is debatable whether this provision requires notification upon the discovery of a crash landing.

[30] Rescue Agreement, *supra* note 16, at art. 5(2).

the launching authority, the state must return the object upon the request of the launching authority.[31] Fourth, Article 5 includes a provision allowing a state to do what is necessary to eliminate any possible danger that might result from a hazardous space object that is found in its territory.[32] Finally, Article 5 places the cost of recovery and return upon the launching authority – a clear distinction from the duty to rescue which does not require reimbursement of expenses incurred by the rescuer.[33]

Article 12(2) of the Moon Agreement simply incorporates Article 5 of the Rescue Agreement by reference and extends it expressly to assets located on the Moon:[34]

> Vehicles, installations and equipment or their component parts found in places other than their intended location shall be dealt with in accordance with article 5 of the [Rescue Agreement].

The practical effect of this provision is small. First, the failure to achieve broad ratification means that few countries are bound by the Moon Agreement. Second, the duty to return space objects under the Moon Agreement does not expand upon the duties imposed by the Outer Space Treaty and the Rescue Agreement – which, as argued above, already applied to lunar activities. The Moon Agreement also requires a State to notify the launching State upon learning of an unintended landing on the Moon.[35]

The application of the duty to return errant spacecraft to private tourism ventures presents fewer problems than are found in the application of the duty to rescue. Namely, there is no controversy regarding the meaning of "astronaut" or "personnel" since the duty to return spacecraft is triggered by the crash of a spacecraft – regardless of who is on board. However, one important question remains regarding the scope of the duty

[31] *Id*. at art. 5(3).
[32] *Id*. at art. 5(4).
[33] *Id*. at art. 5(5).
[34] Moon Agreement, *supra* note 22, at art. 12(2).
[35] *Id*. at art. 13.

to return, namely, whether the duty applies to private commercial spacecraft. This issue is explored in the following section.

III. DOES THE DUTY TO RESCUE AND RETURN APPLY TO SPACE TOURISM?

As shown above, two interpretational issues cloud the question whether the duty to rescue and return applies to tourists. The first issue is whether the duty applies when the spacecraft in distress is a private commercial vehicle. The second issue is whether tourists would be deemed to be "astronauts" or "personnel" under the treaties – and would therefore be able to rely on the assistance of state governments in the event of an accident. These issues will be examined in this Section in accordance with the interpretational canons of the Vienna Convention which, as seen below, ultimately results in a broad interpretation of the duty to rescue and return that encompasses the rescue of space tourists.

A. The Vienna Convention

The Vienna Convention sets forth the rules that govern the creation, operation, and interpretation of treaties. The rules regarding interpretation, contained in Articles 31 through 33 of the convention, provide a systematic process for determining the meaning of treaty provisions.[36] This systematic approach to interpretation will guide the following analysis of the duty to rescue and return in order to arrive at an interpretation that is supported by the authority of the Vienna Convention. Article 30 of the Vienna Convention, which provides rules that are designed to help resolve inconsistencies between treaties, will also be helpful in the following analysis where it is necessary to resolve certain discrepancies between the Outer Space Treaty and the Rescue Agreement.[37]

The primary rule of treaty interpretation under the Vienna Convention is to give the terms of a treaty their "ordinary mean-

[36] Vienna Convention on the Law of Treaties, arts. 31-33, May 23, 1969, 1155 U.N.T.S. 331 [hereinafter Vienna Convention].

[37] *Id*. at art. 30.

ing in their context and in the light of [the treaty's] object and purpose."[38] This "ordinary meaning" should be the meaning that was attributed to a term at the time of the treaty's signing.[39] As indicated in the Vienna Convention, a term should not be interpreted in isolation, but should always be viewed in its greater "context" as well as its "object and purpose." The "context" of a term consists of the text and preamble of the treaty – and must be distinguished from the circumstances of the treaty's conclusion (which are only taken into account for the limited purposes described below).[40] Similarly, a treaty's "object and purpose" are to be determined only from the text of the treaty and not from external sources of information.[41] As reflected in these rules, the Vienna Convention takes a text-centered approach to interpreting treaties that generally requires strict adherence to the text.[42] That being said, the Vienna Convention also requires that any subsequent state practice that sheds light on the proper application of the treaty be taken into account when determining the ordinary meaning of a term.[43]

In the event that the ordinary meaning of a term is ambiguous (or needs to be confirmed) "supplementary means of interpretation" may be applied to provide clarification.[44] These supplementary considerations include the *travaux préparatoires* of the treaty as well as the circumstances of the treaty's conclusion.[45] Recourse to these supplementary considerations is also permitted when the ordinary meaning of a term results in a meaning that is "manifestly absurd or unreasonable."[46]

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[38] *Id*. at art. 31(1).

[39] A. D'Amato, *International Law, Intertemporal Problems*, *in* ENCYCLOPEDIA OF PUBLIC INTERNATIONAL LAW 1234-36 (1992).

[40] Vienna Convention, *supra* note 36, at art. 31(2). *See also* International Law Commission, *Draft Articles on the Law of Treaties with Commentaries* 221 (1966); RICHARD K. GARDINER, TREATY INTERPRETATION 178-89, 343-45 (2008).

[41] GARDINER, *supra* note 40, at 192.

[42] *Id*. at 144-45; *see also* R.H. Berglin, *Treaty Interpretation and the Impact of Contractual Choice of Forum Clauses on the Jurisdiction of International Tribunals: the Iranian Forum Clause Decisions of the Iran-United States Claims Tribunal*, 21 TEXAS INT'L L. J. 39, at 44 (1986).

[43] Vienna Convention, *supra* note 36, at art. 31(3).

[44] *Id*. at art. 32.

[45] *Id*.

[46] *Id*.

When determining the meaning of a treaty, the International Court of Justice (ICJ) can also turn to the official translations of the treaty to see whether the terms used in a translation can assist in clarifying the meaning of a term. Specifically, Article 33(4) of the Vienna Convention states that "when a comparison of the authentic texts discloses a difference of meaning . . . , the meaning which best reconciles the texts, having regard to the object and purpose of the treaty, shall be adopted."[47]

The Vienna Convention rules governing the reconciliation of dissonant treaties also provide helpful guidance in the interpretation of the duty to rescue and return – given the fact that the duty to rescue and return is addressed in multiple treaties that are, in certain respects, inconsistent. Under Article 30, a conflict between two treaties should be resolved by the *lex posteriori* rule which gives precedence to the provisions of the most recent treaty – unless the later treaty specifies that it is subject to the earlier treaty.[48]

Although Article 4 of the Vienna Convention states that the convention only applies to treaties concluded after it enters into force, this does not mean that the rules of interpretation contained in the Vienna Convention should not be applied to the Outer Space Treaty and the Rescue Agreement.[49] The interpretational rules of the Vienna Convention were not drawn from thin air, but are instead a codification of customary practice and are binding as an expression of customary international law.[50] In fact, the ICJ has accepted the Vienna Convention rules as applicable to the interpretation of all treaties, including those that were entered into prior to the conclusion of the Vienna Convention.[51] In light of this, any proposed interpretation of the duty to rescue and return under the space treaties must be carried out in accordance with the Vienna Convention rules. These

[47] *Id*. at art. 33(4).

[48] *Id*. at art. 30(2) & (3).

[49] *Id*. at art. 4.

[50] GARDINER, *supra* note 40, at 14-16, 69. *See also Legal Consequences of the Construction of a Wall in the Occupied Palestinian Territory* (Advisory Opinion) [2004] *ICJ Reports* 38, para 94 (stating that Article 31 of the Vienna Convention expresses the customary international law regarding treaty interpretation).

[51] GARDINER, *supra* note 40, at 14.

rules are put to work in the following sections to resolve the interpretational problems that are relevant to whether the duty to rescue and return applies to space tourists.

B. The Relationship between the Outer Space Treaty and the Rescue Agreement

Before we address the question of whether the duty to rescue and return requires the rescue of space tourists and private spacecraft, the relationship between the Outer Space Treaty and the Rescue Agreement must be clarified. Under the *lex posteriori* rule in Article 30 of the Vienna Convention, the Outer Space treaty applies "only to the extent that its provisions are compatible" with the Rescue Agreement. That the Rescue Agreement was intended to supersede the Outer Space Agreement with respect to the duty to rescue and return is clear. The Rescue Agreement elaborates upon, adds to, and, at times, changes the rules regarding rescue and return set forth in Article V of the Outer Space Treaty. There is no doubt that these changes were intended to supersede the earlier rules, since the drafters would not bother creating a treaty that had no effect. Although the preamble takes note of the Outer Space Treaty and of the Rescue Agreement says that the purpose of the treaty is "to develop and give further concrete expression" to the duty to rescue and return contained in the Outer Space Treaty," this does not rise to the level of explicitly subjecting the Rescue Agreement to the Outer Space Treaty. Therefore, under the operation of the *lex posteriori* rule, the Rescue Agreement must trump the Outer Space Treaty where the terms are inconsistent.[52]

This application of the *lex posteriori* rule gives precedence to the Rescue Treaty with respect to multiple issues that are addressed differently in the Outer Space Treaty. For example, the broader geographic coverage of the duty under the Rescue Agreement supersedes the coverage in the Outer Space Treaty – which left a gap with respect to landings on celestial bodies and Antarctica. Also, the Rescue Agreement's requirement to return

[52] Rescue Agreement, *supra* note 16, fourth recital.

space objects to the "launching authority" replaces the Outer Space Treaty's rule of returning the assets to the state of registry. However, the changes that are of greatest importance to the question of whether the duty to rescue and return applies to space tourism are (1) the use of the term "personnel" in the Rescue Agreement instead of "astronaut" and (2) the omission from the Rescue Agreement of the phrase "envoys of mankind." As explained in greater detail below, the use of the term "astronaut" and the phrase "envoys of mankind" could support a narrower reading of the duty to rescue – one which would likely exclude space tourists and commercial flights. The omission of this language from the Rescue Agreement changes the substance of the law by broadening the scope of the duty to rescue so that it applies to tourists and commercial flights – and this broader scope supersedes the narrower rule of the Outer Space Treaty under the *lex posteriori* rule.

C. Does the Duty to Rescue and Return Apply to Commercial Ventures?

The preliminary question of whether the duty to rescue and return applies to commercial ventures must be resolved before we turn to the more specific issue of whether tourists can be beneficiaries of the duty to rescue.

When interpreting a treaty under the Vienna Convention, the starting point is always the plain language and ordinary meaning of the text. In light of this, the question of whether the duty to rescue and return applies to commercial ventures would appear to require an affirmative answer since nothing in the text of either the Outer Space Treaty or the Rescue Agreement explicitly excludes commercial venture or limits the scope of the duties to government-sponsored missions. However, in the interest of being thorough, attention should be paid to certain key terms that have a bearing on the scope of the duty to rescue and return to see whether their meaning might operate to restrict the scope of the treaty to government activity. These key terms are "astronaut" and "space vehicle" (in the Outer Space Treaty) and "personnel," "space object," and "spacecraft" (in the Rescue Agreement). None of the terms in the Rescue

Agreement exclude commercial enterprises in their ordinary meaning – in fact, "personnel" is typically used in a commercial context (e.g., cruise ship personnel) as well as in government contexts. This lack of any distinction between private and public spaceflight in the plain language of the Rescue Agreement supports a broad interpretation which would require states to rescue non-governmental personnel and return private spacecraft.

The analysis of the Outer Space Treaty may point at a different result because, as discussed in greater detail below, one could argue that the ordinary meaning of "astronaut" at the time of the signing of the Outer Space Treaty would have been understood to include only the members of the crew on government-sponsored missions. However, as is also explained below, the application of the *lex posteriori* rule results in the Rescue Agreement superseding Article V of the Outer Space Treaty – which deprives the term "astronaut" of any operative force in the context of rescue and return.

An analysis of state practice under Article 31 of the Vienna Convention also supports extending the application of the Rescue Agreement to commercial spacecraft. Although no state has yet been required to fulfill its duty to rescue astronauts, the record is a little richer with respect to the return of space objects. There have been seven instances of space objects being found on Earth resulting in the notification of the Secretary-General and the return of the assets to the launching authority.[53] Five of these episodes involve the discovery of government assets – but two involve the discovery of private spacecraft. Specifically, the governments of Argentina and South Africa, in 2000 and 2004, respectively, notified the Secretary-General of the discovery and planned return to the United States of space objects that had been found in their respective territories.[54] In both cases, the governments had determined prior to giving notification that the space objects were parts of *Delta II* launch vehicles which –

[53] Frans G. von der Dunk, *A Sleeping Beauty Awakens: The 1968 Rescue Agreement after Forty Years,* 34 J. SPACE L. 411, 426-31 (2008).

[54] U.N. Doc. A/AC.105/825 *at* http://www.unoosa.org/oosa/sdnps/unlfd.html; U.N. Doc. A/AC.105/740 *at* http://www. unoosa.org/oosa/sdnps/unlfd.html.

although they delivered government payloads – were owned by a private company, namely, the Boeing Company. Thus, we have some evidence of States extending the duty to return to privately-owned commercial vehicles. And if States feel compelled under the law to fulfill the duty to return private vehicles, there is no reason why the other duties imposed by the treaty, including the duty to rescue, should be viewed any differently.

On the other side of the argument is an oft-cited comment made by the French delegate at the presentation of the Rescue Agreement to the General Assembly. In his comment, the delegate clearly announces that the duties of the Rescue Agreement were not intended to apply to commercial ventures. The relevant part of the comment is reproduced here:[55]

> Before concluding, I should like to emphasize that the text of the convention, as the French Government understands it, applies in full only to flights that are experimental and scientific in nature. The rights of the signatory States must be fully reserved for the time when such flights may become utilitarian or commercial in character, at which time it will doubtless be necessary to negotiate a new convention.

Although this comment would seem to carry great weight due to the fact that it specifically addresses the issue at hand, it cannot be allowed to control the meaning of the treaty. First of all, it is only the opinion of one State that is expressed and there were likely to have been other views. But more importantly, this instance of *travaux préparatoires* does not enter the analysis according to the rules of the Vienna Convention. Under Article 32 of the Vienna Convention, recourse to the *travaux préparatoires* is only allowed for the purpose of *confirming* – not challenging – the ordinary meaning of the treaty language (unless the language is deemed ambiguous or absurd, which is not the case here since the treaty language clearly encompasses both government and commercial operations). Although disregarding the comment of the French delegate may seem imprudent to some, the Vienna Convention rules were written to give primacy

[55] *Provisional Verbatim Record*, *supra* note 9, at 42.

to the written word for the purpose of limiting recourse to the easily manipulated morass of *travaux préparatoires*.

In addition to the foregoing arguments under the Vienna Convention, the extension of the duty to rescue and return to commercial ventures is also reasonable because it would be consistent with the approach of other duties under the space treaties. For example, Article VI of the Outer Space Treaty extends the application of the treaty to private space operations by requiring that States supervise the space activity of non-governmental entities and bear responsibility for any failure of non-governmental entities to comply with the treaty.[56] It is also generally accepted that a launching state must register under the Convention on Registration of Objects Launched into Outer Space.[57] Similarly, a State is liable for any damage caused by space objects launched from its territory (or whose launch the state procures) under the Convention on International Liability for Damage Caused by Space Objects – whether such objects are owned by the government or a private entity.[58]

Finally, an overwhelming majority of commentators agree with extending the benefits of not only the duty to rescue and return, but of the entire body of space law, to commercial participants.[59] Although the views of commentators do not enter

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[56] Outer Space Treaty, *supra* note 11, at art. VI.

[57] Convention on Registration of Objects Launched into Outer Space, art. 1, Jan. 14, 1975, 1023 U.N.T.S. 15; see also *Practice of States and International Organizations in Registering Space Objects: Replies from Member States*, U.N. Document A/AC.105/C.2/L.250/Add.1 p. 3 (reporting that France "registers national satellites, whether they belong to government organizations or private companies.").

[58] Convention on International Liability for Damage Caused by Space Objects, arts. II & III, Mar. 29, 1972, 961 U.N.T.S. 187 [hereinafter Liability Convention]. Regarding the liability of launching states for harm caused by commercial ventures see Bruce A. Hurwitz, *Liability for Private Commercial Activities in Outer Space*, *in* PROCEEDINGS OF THE THIRTY-THIRD COLLOQUIUM ON THE LAW OF OUTER SPACE 37, 39 (1991); Ricky J. Lee, *Reconciling International Space Law with the Commercial Realities of the Twenty-First Century*, 4 SING. J. INT'L & COMP. L. 194, 230 (2000).

[59] *See*, *e.g.*, I.H. Ph. Diederiks-Verschoor & W. Paul Gormley, *The Future Legal Status of Nongovernmental Entities in Outer Space: Private Individuals and Companies as Subjects and Beneficiaries of International Space Law*, 5 J. SPACE L. 125, 155 (1977).; Frans G. von der Dunk, *Space for Tourism? Legal Aspects of Private Spaceflight for Tourist Purposes*, *in* PROCEEDINGS OF THE FORTY-NINTH COLLOQUIUM ON THE LAW OF OUTER SPACE (2007); Robert C. Beckman, *1968 Rescue Agreement – An Overview*, *in* UNITED NATIONS TREATIES ON OUTER SPACE: ACTIONS AT THE NATIONAL LEVEL 85

into interpretational analysis under the Vienna Convention, such opinions can themselves have the force of law under Article 38 of the Statute of the International Court of Justice.[60]

D. Are Space Tourists Beneficiaries of the Duty to Rescue?

Even if the duty to rescue extends to commercial spaceflight, the question still remains whether the law only requires states to rescue crew members, or private passengers as well. As discussed above, the Moon Agreement requires that states take actions to safeguard the lives of "all persons on the moon." The phrase "all persons" is sufficiently generic to embrace government astronauts, scientists, tourists, and any other people on the Moon. However, the Outer Space Treaty and the Rescue Agreement use narrower terms when they require the rescue of "astronauts" and "personnel," respectively. Whether these terms can be interpreted as including space tourists is an open question – but the Vienna Convention proves to be helpful in arriving at a broad interpretation of the duty, i.e., one that allows tourists to benefit from the rescue duty.

The Outer Space Treaty's use of the term "astronaut" has been understood by some commentators to limit the duty to rescue to (1) the pilot and crew[61] or (2) the pilot, crew, and any professional performing a service on board.[62] Under either approach, private passengers would be excluded. However, it is debatable whether "astronaut" carries such a limited meaning when analyzed under the Vienna Convention.[63] According to

(2004); Setsuko Aoki, *Commentary on 1968 Rescue Agreement – An Overview*, *in* UNITED NATIONS TREATIES ON OUTER SPACE: ACTIONS AT THE NATIONAL LEVEL 407 (2004).

[60] Statute of the International Court of Justice, art. 38, June 26, 1945, 59 Stat. 1055, 33 U.N.T.S. 993.

[61] *See*, *e.g.*, Dembling & Arons, *supra* note 20, at 642.

[62] Stephen Gorove, *Interpreting Salient Provisions of the Agreement on the Rescue of Astronauts, The Return of Astronauts, and the Return of Objects Launched into Outer Space*, *in* PROCEEDINGS OF THE ELEVENTH COLLOQUIUM ON THE LAW OF OUTER SPACE 93, 93 (1969); Elina Kamenetskaya, *"Cosmonaut" ("Astronaut"): An Attempt of International Legal Definition*, *in* PROCEEDINGS OF THE THIRTY-FIRST COLLOQUIUM ON THE LAW OF OUTER SPACE 177, 177-78 (1989); von der Dunk, *supra* note 59.

[63] For commentators who support a broad reading of "astronaut" to include everyone on board a spacecraft, *see*, *e.g.*, Bin Cheng, *"Space Objects", "Astronauts" and Related Expressions*, *in* PROCEEDINGS OF THE THIRTY-FOURTH COLLOQUIUM ON THE LAW OF

the 1972 *Oxford English Dictionary*, the meaning of "astronaut" is "one who travels in space, i.e. beyond the earth's atmosphere" or "a student or devotee of spaceflight."[64] Putting "students and devotees of astronautics" aside, this dictionary definition is virtually identical to the definition of "astronaut" set forth in the 1965 edition of the *Dictionary of Technical Terms for Aerospace*, which includes in the definition of "astronaut" (1) those who engage in space flight and (2) those who train for spaceflight.[65] There is nothing in the first definition that would exclude private passengers (nor in the second definition since, at least under the law of the United States, tourists will undergo training for their flight).[66] Because there is no ambiguity regarding the inclusion of passengers in either definition (since neither definition exclude passengers), supplementary means of interpretation can only be applied to confirm the inclusion of passengers – but not challenge it.

On the other hand, an argument could be made that the ordinary meaning of "astronaut" at the time of the signing of the Outer Space Treaty would have included only the crewmembers and technicians on government-mounted missions. After all, the drafters of the Outer Space Treaty were creating the treaty at a time when only governments had the ability to put objects into space and private space use was an impossibility.[67] This

OUTER SPACE 17, 26 (1992); Ryszard Hara, *Legal Status of Astronauts and Other Personnel on the Moon*, *in* PROCEEDINGS OF THE TWENTY-SIXTH COLLOQUIUM ON THE LAW OF OUTER SPACE 165, 165 (1984) (relying on comments by the Italian delegation to the legal subcommittee).

[64] *Astronaut*, A SUPPLEMENT TO THE OXFORD ENGLISH DICTIONARY (1972). *See also*, WEBSTER'S THIRD NEW INTERNATIONAL DICTIONARY (1967) (defining "astronaut" as "a traveler in interplanetary space").

[65] Kamenetskaya, *supra* note 62, 177 (*citing* DICTIONARY OF TECHNICAL TERMS FOR AEROSPACE USE 16 (1965)).

[66] Human Space Flight Requirements for Crew and Flight Participation, 71 Fed. Reg. 75616, 75626 (Dec. 15, 2006) (to be codified at 14 C.F.R. §460.51) (requiring an operator to train each space flight participant before flight on how to respond to emergency situations, such as fire and loss of cabin pressure).

[67] In a recent article, Professor Stephan Hobe explains that the term "astronaut" differs from "personnel" in that "'astronaut' has a more explorative or scientific meaning, [while] personnel has a more functional meaning." Stephan Hobe, *Legal Aspects of Space Tourism*, 86 NEB. L. REV. 439, 455 (2007). Professor Hobe thus recognizes that "astronaut" may have held a specialized meaning that would have excluded passengers. *Id*.

would coincide with the current internal regulations of the United States Air Force which grant an astronaut rating only to Air Force officers (and not private parties) who perform duties fifty miles or more above the Earth's surface.[68] Confirmation of this interpretation is also found in the Russian translation of the Outer Space Agreement, which uses the word "cosmonaut" rather than "astronaut." As explained above, Article 33(4) of the Vienna Convention permits recourse to translated versions of a treaty to assist in interpretation. According to the 1970 edition of *Kosmonavtika: Malenkaya entsiklopediya* a "cosmonaut" is a person who is a pilot or crew member of a space vehicle who is specially trained in a medical, biological, scientific or technical field, and, therefore, the term "cosmonaut" would not include private passengers.[69]

Proponents of a narrow interpretation of "astronaut" also point to the use of the phrase "envoys of mankind" in reference to astronauts in the Outer Space Treaty.[70] It can be argued that this phrase serves as relevant context that should be taken into account when determining the "ordinary meaning" of astronaut. However, the significance of the phrase "envoys of mankind" is questionable.[71] Historically, envoys are representatives of government and, therefore, it is not surprising that commentators find in the word an indication that "astronaut" should be defined as participants in a government operation. However, no

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[68] *See* Air Force Instruction 11-402, Aviation and Parachutist Service, Aeronautical Ratings and Badges, Sept. 27, 2007, para. 2.3.2, *available at* http://www.e-publishing.af.mil/shared/media/epubs/AFI11-402.pdf.

[69] Kamenetskaya, *supra* note 62, at 177 (citing *Kosmonavtika: Malenkaya entsiklopediya* 239 (1970)). Under the authority of an interim measure, the Federal Aviation Administration has awarded "Commercial Astronaut Wings" the two commercial pilots who piloted *SpaceShipOne* to victory in the X-Prize competition, Mike Melvill and Brian Binnie. See Commercial Space Data – Active Licenses, Federal Aviation Administration Website, at http://www.faa.gov/about/office_org/headquarters_offices/ast/ launch_data/ current_licenses. However, it is not clear that such astronaut wings will be awarded to mere passengers on future commercial tourist flights.

[70] See, *e.g.*, I.H. Ph. Diederiks-Verschoor, *Search and Rescue in Space Law*, *in* PROCEEDINGS OF THE NINETEENTH COLLOQUIUM ON THE LAW OF OUTER SPACE 152, 156 (1977).

[71] Cheng, *supra* note 63, at 25 (asserting that the phrase "envoys of mankind" is "no more than a figure of speech without any legal significance."); *see also* V.S. Vereshchetin, *Legal Status of International Space Crews*, *in* PROCEEDINGS OF THE TWENTY-FIRST COLLOQUIUM ON THE LAW OF OUTER SPACE 164 (1979).

State has the authority to appoint an "envoy of mankind." This concept is supranational and therefore any person, whether a government agent or private person, has equal claim to the title "envoy of mankind." The insignificance of the phrase is also indicated by its omission from the Rescue Agreement. From this perspective, the phrase fails to impose any limitation on the meaning of astronaut and therefore opens the door to a broader definition that includes anyone on board a spacecraft, including passengers.

Although the foregoing debate is an interesting one, the issue regarding the meaning of astronaut is a moot point because, as discussed above, the Rescue Agreement supersedes the Outer Space Treaty with respect to the duty to rescue under the *lex posteriori* rule. The Rescue Agreement employs the phrase "personnel of a spacecraft" to describe the beneficiaries of the duty to rescue rather than "astronaut" – and this inconsistency is resolved in favor of the later treaty. As a result, space tourism companies only need to concern themselves with the question of whether "personnel" includes their passengers.

With respect to the meaning of "personnel," we begin the analysis once again with its ordinary meaning. According to the 1968 edition of *Webster's New World Dictionary*, "personnel" means "persons employed in any work, enterprise, service, etc."[72] On a positive note, this definition is broad in the sense in that it carries no connotation of government activity (as "astronaut" is more likely to carry), thus allowing for the duty to rescue to extend to personnel of commercial flights. However, the phrase "personnel of a spacecraft" is narrow in the sense that it would only cover the pilot, crew, and other service providers on board, while private passengers (who provide no service on board) would be excluded from the ordinary meaning of the term.[73] There are a number of commentators who would like to define "personnel" broadly so that it would include space tour-

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[72] *Personnel*, WEBSTER'S NEW WORLD DICTIONARY (1968).

[73] Both Stephen Gorove and Bin Cheng reluctantly agree that "personnel" would exclude passengers, although Prof. Cheng makes a point of noting that the drafters of the Rescue Agreement did not intend this result. Gorove, *supra* note 62, at 93; Cheng, *supra* note 63, at 165.

ists – but the challenge is achieving a broad definition in a manner that complies with the customary law of treaty interpretation as codified in the Vienna Convention.[74] The remainder of this section explores potential methods for expanding the scope of "personnel" beyond its dictionary definition.

The simplest solution would be to find support for the contention that the ordinary meaning of personnel at the time of drafting was in fact sufficiently broad so as to include private passengers on a spaceplane. The unforgivingly narrow dictionary definition of the term would make this argument difficult. However, in making this argument one could point to the use of the term "personnel" in Article VIII of the Outer Space Treaty, which is reproduced here:[75]

> A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any *personnel* thereof, while in outer space or on a celestial body.

Scholars have not hesitated to interpret "personnel" in this context broadly to include any and all people on board a spacecraft – which was certainly the intention of the drafters.[76] And if "personnel" was used to refer to all persons in the Outer Space Treaty, it could be argued that this was an ordinary meaning of

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[74] Commentators who have adopted an interpretation of "personnel" that would include private passengers include Dembling & Arons, *supra* note 20, at 642; MANFRED LACHS, THE LAW OF OUTER SPACE 79 (1972); Gabriella Catalano Sgrosso, *Legal Status of the Crew in the International Space Station*, *in* PROCEEDINGS OF THE FORTY-SECOND COLLOQUIUM ON THE LAW OF OUTER SPACE 35, 36, 40 (2000) (citing the NASA definition of "personnel"); Oscar Fernandez-Brital, *Legal Problems of Commercial Space Transportation*, *in* PROCEEDINGS OF THE THIRTY-THIRD COLLOQUIUM ON THE LAW OF OUTER SPACE 30, 33 (1991); Beckman, *supra* note 59, at 88; Steven Freeland, *Up, Up and . . . Back: The Emergence of Space Tourism and its Impact on the International Law of Outer Space*, 6 CHI. J. INT'L L. 1, 10 (2005). Moreover, the recent United Nations Workshop on Space Law held in South Korea concluded that "the term 'personnel of a spacecraft' . . . should be construed to encompass all persons on board a spacecraft." U.N. Doc. A/AC.105/814 at 6.

[75] Outer Space Treaty, *supra* note 11, at art. VIII.

[76] MANNED SPACE FLIGHT, *supra* note 2, at 194; *see also* Hobe, *supra* note 67, at 455.

the term that should also be adopted when interpreting the Rescue Agreement.[77]

Another approach to seeking a broad definition of "personnel" is to take into account the humanitarian purpose of the Rescue Agreement when interpreting the term as is required under Article 31 of the Vienna Convention. That the main principle and purpose behind the Rescue Agreement was the humanitarian desire to protect the life of those aboard a spacecraft is reflected in the treaty's fourth recital which states that the treaty was "prompted by sentiments of humanity."[78] However, the use of the object and purpose of a treaty for interpretational purposes has its limits. Although the object and purpose can be used to help the ICJ select among competing "ordinary meanings" of a term, the object and purpose cannot be used to overrule the accepted meaning of a term and, in effect, allow for the creation of a definition that has no basis in the term itself. Since the dictionary definition of "personnel" refers to a service provider, it is not possible to ignore this and simply create a new definition of "personnel" that would embrace private passengers on the basis of the humanitarian nature of the treaty.

Another way of achieving a broad reading of "personnel" would be to interpret the term in light of *travaux préparatoires* that would support an expansive definition. Such *travaux* exists in the form of the following comment by the Italian delegation, which had followed the lead of the United States by employing the term "personnel" in their proposed text of the Rescue Agreement:[79]

> [The text proposed by Italy] refers to personnel (or crew) and not specifically to astronauts, since *everyone on board* has a right to assistance for humanitarian reasons."

This comment that "everyone on board" has a right to rescue indicates that the drafters understood the term broadly in a way

[77] GARDINER, *supra* note 40, at 283 (explaining that the use of the same term in another treaty is relevant to determining the ordinary meaning of the term in the first treaty).

[78] Rescue Agreement, *supra* note 16, at recitals.

[79] *Proposals, amendments and other documents relating to assistance to and return of astronauts and space vehicles*, U.N. Doc. A/AC.105/37 Annex I at 10.

that should even include private passengers. However, under Article 31 of the Vienna Convention, *travaux préparatoires* can only be used to assist in interpretation when ambiguity exists in the text, i.e., when a term is not "clear."[80] This prevents the use of *travaux* in this case, since there is no ambiguity in the term "personnel." The term is commonly understood to refer only to service providers and never to passengers, guests or the like. Therefore, we must seek another course to a broad interpretation of the term.

Another argument in support of a broad interpretation of "personnel" might be made under Article 33(4) of the Vienna Convention if it can be shown that the translation of "personnel" in the Spanish, French, or Chinese versions of the treaty referred to all persons on board a spacecraft. The Rescue Agreement supports this approach in Article 10 which states that the texts of the treaty in various languages are equally authentic and carry the same weight.[81] In pursuit of this line of argument, the translations of the word "personnel" in the French, Spanish, Russian, and Chinese versions of the Rescue Agreement have been analyzed in order to see whether the words used in these versions of the treaty might expand the scope of the duty to rescue to include passengers. However, the results of this analysis are not helpful since all of the translations use terms that mean "crew" – which is even narrower in meaning than "personnel" (which encompasses not only the crew, but also other service providers and professionals on board). The French version uses the word "l'équipage" where "personnel" is used in Article 2 and 3, while the Spanish version uses the term "la tripulación." The Russian and Chinese versions of the Rescue Agreement follow in the same vein. The Russian version uses the word "э́кипаж," which is simply a transliterated version of the French word "équipage" and carries the same meaning. Similarly, the Chi-

[80] International Law Commission, *supra* note 40, at 223; *see also* Prosecutor v. Dusko Tadic´, [1999] ICTY 2, 124 ILR 61 at 183-84 (1999), para. 303 (stating that the "*travaux préparatoires* . . . may only be resorted to when the text of a treaty . . . is *ambiguous or obscure*.").

[81] Rescue Agreement, *supra* note 16, at art. 10.

nese version employs the word “yen ruan” which also translates as “crew.”

Even if all of the previous arguments fail, we are left with a final possibility – that the ordinary meaning of “personnel” results in absurdity under Article 31 of the Vienna Convention, thereby allowing recourse to *travaux préparatoires* (such as the comment from the Italian delegation reproduced above) that support an interpretation that would include tourists. However, it is first necessary to establish that the use of the term “personnel” results in absurdity – which is not difficult to do. Imagine, for example, that one of Virgin Galactic’s spaceplane crashes in stormy waters just off the coast of a foreign country. Under a narrow reading of “personnel,” the nearby state would be required to rescue the pilot and other crewmembers, but would be free to leave the passengers to face their destiny on the high seas. This scenario could not have been contemplated by the drafters of the Rescue Agreement since there is no reason why the duty to rescue would be limited in this way. Once the rescue expedition had reached the spacecraft, there is no sense in only rescuing some of the people in danger, but not others. This is a ridiculous scenario that would support a finding of absurdity.[82] Facing such absurdity, the ICJ would be forced to remedy the flawed language of the Rescue Agreement by giving “personnel” a broader meaning that would encompass space tourists.

IV. THE WAY FORWARD: REFORMING THE LAW TO BENEFIT SPACE TOURISM

The purpose of this article is not merely to describe the current state of law regarding the rescue of astronauts and the return of spacecraft. Although there is value in informing existing tourism companies of the contours of existing law and how the law can benefit their operations, this study was also undertaken in order to identify those aspects of the current law that need to be reformed in order to meet the needs of the private space in-

[82] Other commentators have noticed the absurdity of this situation. *See*, *e.g.*, Freeland, *supra* note 74, at 10; Beckman, *supra* note 59, at 88.

dustry. Those issues that demand further clarification, or are in need of more substantial reform, include the following:

1. *Does the duty to rescue and return apply to commercial ventures?*
2. *Is there is a duty to rescue passengers?*
3. *Is a suborbital spacecraft a "space object"?*
4. *Should the requirement under the Rescue Agreement that personnel "alight" prior to the rescue duty being triggered be abolished?*
5. *Does the duty to rescue and return apply during all stages of flight?*
6. *What is the definition of "launching authority"?*
7. *Should expenses for rescue be reimbursed?*
8. *Should the notification requirement under Art. 5 of the Rescue Agreement be expanded to include notification regardless of where the accident occurs?*
9. *Should the duty to return be triggered by the request of a private party?*
10. *Should spacecraft design standards be implemented to facilitate rescue?*

Before recommending specific solutions to these issues, it is instructive to observe the work product of three leading figures of space law, Prof. Karl-Heinz Böckstiegel, Prof. Stephen Gorove, and Prof. Vladlen Vereshchetin, who joined efforts in 1988 to write the *Draft for a Convention on Manned Space Flight* (the "Draft Convention"), which was an attempt to create a new body of rules to address the perceived needs of future space industries.[83] Given the usefulness of this draft convention as a source of ideas, the entire text of Article VI of the convention, addressing the rescue of astronauts, is reproduced here:[84]

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[83] MANNED SPACE FLIGHT, *supra* note 2, at 7.
[84] *Id.* at 11.

Article VI Mutual Assistance in Space

1. In accordance with Art. V of the Outer Space Treaty and the respective provisions of the Rescue Agreement, the crew participating in a manned space flight of a State Party to this Agreement shall render all possible assistance, including, if necessary, the provision of shelter on their manned space objects, to person who are experiencing conditions of distress in outer space or on celestial bodies.

2. To facilitate such assistance, the States Parties to this Agreement shall study and exchange information on possible steps to ensure the compatibility of manned space objects and technical means for carrying out rescue operations in outer space.

3. Any information received by a State Party to this Agreement concerning an emergency on a manned space object of another State shall be immediately transmitted to the launching State and to the Secretary-General of the United Nations in accordance with Art. I of the Rescue Agreement so that any State may come to the rescue of the persons experiencing conditions of distress.

4. In the event of an emergency situation arising on a manned space object, the States Parties to this Agreement shall ensure by all possible means that communication to and from the manned space object in distress shall be available and that they shall not interfere with such communication.

5. Unless otherwise agreed by the States Parties concerned, the expenses incurred by a State Party or by another State in rendering assistance to a manned space object in distress shall be borne by the launching State of that object, if the launching State has been informed in advance of the assistance and has not objected.

6. States shall regard any person in outer space as an astronaut within the meaning of Art. V of the Outer Space Treaty and as part of the personnel of a spacecraft within the meaning of Art. VIII of the Outer Space Treaty and the Rescue Agreement.

The Draft Convention has been the most comprehensive attempt to reform existing space law in order to accommodate the needs of a private spaceflight. Nevertheless, however progressive this Draft Convention may be, it is not the final word on space law reform. In some cases, the provisions of the Draft Convention provide valuable guidance, while in other cases it falls short. However, even in its shortcomings the Draft Convention has proved to be helpful in the formation of the following recommendations.

1. *The extension of the duty to rescue and return to commercial ventures should be made explicit.* Although I have argued above that the existing duty to rescue and return applies to commercial ventures, private companies will want clarity on this point. Clarity can be provided by reforming the law to make explicit that the rights, duties, and obligations contained in the treaties apply to commercial ventures. Although no such explicit statement is contained in Article VI of the Draft Convention regarding mutual assistance, the Draft Convention does propose to extend liability to states for damage caused by any of its space flights "irrespective of whether they are carried out by governmental or non-governmental entities."[85] This language is a useful model for how obligations under the existing law of rescue and return can be extended to cover private ventures. However, care must be taken when drafting this language. If the language is overly broad and extends all duties and obligations contained in the Rescue Agreement to private entities this would have the effect of requiring private companies to engage in rescue operations themselves. The duty of private parties to engage in rescue missions would potentially place a great burden on companies that are already subject to great financial pressures. In Article VI, the Draft Convention extends the duty to rescue to the crew of a spacecraft – thus requiring not only states to mount rescue expeditions, but requiring the pilots and crew of any spacecraft to engage in rescue operations if possible. This debate regarding the extension of the duty to rescue to private parties was recently taken up in two papers delivered at

[85] MANNED SPACE FLIGHT, *supra* note 2, at 12.

the 2008 International Astronautical Conference in Glasgow and is adequately handled there.[86] However, in this early phase of the space tourism industry, the question of whether private parties can benefit from the duty to rescue is more important than whether the duty to rescue should be imposed on private parties.

2. *"Astronaut" and "personnel" should be defined to include passengers.* Although there are strong arguments that the terms "personnel" and "astronaut" should be interpreted under the Vienna Convention to include passengers, it would be preferable to make the scope of the duty clear by stating explicitly that states must rescue all persons on board a spacecraft. This could be achieved simply by clarifying that the duties set forth in the Outer Space Treaty and the Rescue Agreement apply to all persons on board a spacecraft – as is stated in Article V(6) of the Draft Convention.

3. *The definition of "space object" should be clarified.* A threshold question that must be resolved to ensure that suborbital tourism companies will be able to benefit from current space treaties is whether suborbital spacecraft will be deemed to be "space objects" under the Outer Space Treaty and "spacecraft" under the Rescue Agreement. Virgin Galactic and the other suborbital tourism companies will be sending their tourists 100 kilometers above Earth, which is widely acknowledged to be the lower limits of space – since it crosses the so-called Karman Line. However, the question of where space begins has been the subject of a long-running debate that has yet to be resolved.[87] Some would argue that space begins significantly higher than the Karman Line. For example, the national laws of some countries recognize space as beginning at an altitude where orbit can

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[86] Kevin Comer, *A New Indemnification Policy for Spacecraft that Rescue Astronauts in Need*, *in* PROCEEDINGS OF THE FIFTY-FIRST COLLOQUIUM ON THE LAW OF OUTER SPACE 8 (2009); Zeldine Niamh O'Brien, *The Rescue Agreement and Private Space Carriers*, *in* PROCEEDINGS OF THE FIFTY-FIRST COLLOQUIUM ON THE LAW OF OUTER SPACE (2009).

[87] For a discussion of the definition of "space object" *see*, *e.g.*, I.H. PH. DIEDERIKS-VERSCHOOR & V. KOPAL, AN INTRODUCTION TO SPACE LAW 88-90 (2008); Vladimir Kopal, *Some Remarks on Issues Relating to Legal Definitions of "Space Object", "Space Debris", and "Astronaut," in* PROCEEDINGS OF THE THIRTY-SEVENTH COLLOQUIUM ON THE LAW OF OUTER SPACE 99 (1994).

be sustained. Settling this question is of great importance to the suborbital tourist industry in order to ensure that suborbital flights come within the protection of the duty to rescue and return. This can be achieved by making clear that space begins at 100 kilometers above sea level. Under such a definition of space, suborbital vessels would be treated as "space objects" and "spacecraft."

4. *The requirement under the Rescue Agreement that personnel "alight" prior to the rescue duty being triggered should be abolished.* As explained above in Section II, the language of the Rescue Agreement requiring that the personnel "alight" prior to the rescue duty being triggered may be interpreted to rule out any duty to rescue personnel traveling in space. In order to remedy this gap in the treaty, the law should be reformed to provide for rescue when persons aboard a spacecraft are in distress (or, to state this duty even more broadly, whenever persons on board a spacecraft *or elsewhere in space* are in distress – for example, if tourists are stranded in a lunar hotel).

5. *The duty to rescue and return should apply during all stages of flight.* Since it is likely that a mishap involving a suborbital flight could occur before the vessel reaches space, resulting in an unplanned landing in a foreign territory, the duty to rescue and return must be revised in a manner that allows for the duty to be triggered even if the spacecraft never reaches space. The Draft Convention attempts to broaden the duty to rescue in this manner by defining "manned space flight" in the following way:[88]

> [A] flight of a space object with a person or persons on board from Earth to outer space or in outer space and *extends to the embarkation, launch, in orbit, deorbit, reentry, landing and disembarkation*.

While the intent of the drafters is clearly that the duties of the convention apply to all stages of a flight, there is still room to question this conclusion if the definition of "space object" or "spacecraft" does not explicitly state that such term includes an

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[88] MANNED SPACE FLIGHT, *supra* note 2, at 8 (emphasis added).

object or spacecraft that does not achieve outer space. None of the existing conventions define spacecraft or space object – except for the Liability Convention which defines space object as including "component parts of a space object as well as its launch vehicle and parts thereof," which definition fails to address the issue at hand.[89] Article 5 of the Rescue Agreement also fails to resolve the issue by stating that the duty to return applies to "objects launched into outer space," which suggests that objects that are intended to reach outer space but fall short of this goal will not benefit from the duty to return.[90] Nor does the Draft Convention sufficiently handle the issue in its definition of "manned space object" which is defined as "a space object on which a person or persons effect a space flight."[91] This definition suggests that only objects which have "effected" a space flight (i.e., have reached outer space) are subject to the treaty. One solution would be to adopt a definition of "space object" and "spacecraft" that would include those objects that were launched into space as well as those objects that were launched with the intention of reaching space, but failed to do so.

6. *The definition of "launching authority" should be clarified.* The "launching authority" plays a central role in the operation of the Rescue Agreement in a number of ways. For example, notification regarding an unintended landing is to be given to the launching authority, personnel and errant spacecraft are to be returned to the launching authority, and the expenses of salvage are to be borne by the launching authority.[92] However, there are significant problems with the definition of "launching authority" in light of the multi-national and supranational nature of current space operations. Before highlighting these problems, the following definition of "launching authority" set forth in the Rescue Agreement should be considered:[93]

> [T]he term "launching authority" shall refer to the State responsible for launching, or, where an international intergov-

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[89] Liability Convention, *supra* note 58, at art. I(d).
[90] Rescue Agreement, *supra* note 16, at art. 5(3).
[91] MANNED SPACE FLIGHT, *supra* note 2, at 8.
[92] Rescue Agreement, *supra* note 16, at arts. 1, 4 & 5.
[93] *Id*. at art. 6.

> ernmental organization is responsible for launching, that organization . . . .

In short, the Rescue Agreement defines "launching authority" as the state that is "responsible for launching." The problem with this definition is that a state may not qualify as being "responsible for launching" a space object when the space venture is private in nature. The analysis is further complicated if a launch takes place in extra-jurisdictional territory, such as the high seas. In order to avoid these complications, the definition of launching authority should be clarified so that no doubt will arise regarding the state that is subject to the duties and benefits of the treaty. The simplest solution would be to define launching authority as the state that has registered the space object under the Registration Treaty.[94]

7. *Expenses for rescue should be reimbursed.* Perhaps the clearest indication of the humanitarian nature of the Rescue Agreement is that there is no requirement for the launching authority to reimburse a rescuing State for the costs of a rescue operation. Although the sentiment is commendable, this lack of a compensation requirement could in the end hamper rescue efforts since the duty to rescue is only triggered if a State is "in a position to do so."[95] The danger is that a State may take finances into consideration when deciding whether it is in a position to undertake rescue operations – particularly if space rescue is demanded. As a result, it would be in the best interests of the space industry to require the reimbursement of funds spent on rescue, just as the costs of retrieving a spacecraft are to be borne by the launching authority. Whether a State will then demand that such costs be subsequently reimbursed by the private company that received the benefits of the rescue should be left to domestic law.[96]

8. *The notification requirement under Art. 5 of the Rescue Agreement should be expanded to include notification regardless*

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[94] For an example of an early debate on this issue see the joint comment by Australia, Canada, and the USSR see *Proposals, amendments and other documents relating to assistance to and return of astronauts and space vehicles*, *supra* note 79, at 12.

[95] Rescue Agreement, *supra* note 16, at art. 3.

[96] *See* Comer, *supra* note 86; O'Brien, *supra* note 86, at 8-9.

of where the accident occurs. The sharing of information about an emergency involving a spacecraft is imperative to ensure that rescue operations are quickly dispatched and that any developments in the situation are transmitted to all parties involved during the course of rescue and retrieval of a spacecraft. While Articles 1 and 2 the Rescue Agreement requires a State to notify the launching authority upon learning of personnel of a spacecraft being in distress – regardless of where the spacecraft is located – and to provide updates regarding any rescue operations, this notification requirement is curtailed with respect to retrieval operations.[97] Under Article 5, notification about the discovery of an errant spacecraft is only required if the spacecraft or its component parts has returned to Earth.[98] This duty to notify should be expanded in two ways. First, the duty to notify should be expanded to require the sharing of all information with the launching authority regarding the discovery of an errant spacecraft (similar to the language used in Article VI(4) of the Draft Convention). Second, the duty should be expanded to cover the sharing of information regarding errant spacecraft regardless of where the spacecraft is located – on the Earth, in space, or on a celestial body.

9. *The duty to return should be triggered by the request of a private party*. As currently drafted, Article 5 of the Rescue Agreement only requires a State to retrieve an errant spacecraft upon the request of the launching authority. This provision should be revised to allow this duty to be triggered either upon the request of the launching authority or the owner of the spacecraft. This would enable recovery operations to be launched more quickly without the private owner of a spacecraft having to go through governmental channels in order to request recovery.

10. *Spacecraft design standards should be implemented to facilitate rescue*. Although rescue operations involving suborbital flights are likely to involve nothing more than locating and recovering the spacecraft when it has returned to Earth, rescue will be more complicated in those situations where spacecraft

[97] Rescue Agreement, *supra* note 16, at arts. 1 & 2.
[98] *Id*. at art. 5(1).

face emergencies in orbit, in deep space, or on a celestial body. In those cases, it may be necessary for a rescue vehicle to dock with the vehicle in distress so that the people on board can be transferred to the rescue vehicle and returned to Earth. In order to facilitate such space rescue operations, it would be helpful if hatch design were standardized to allow for docking between all spacecraft. This could be achieved through an international instrument that requires the domestic laws of signatories to impose a standard design such as the Common Berthing Mechanism that is used by vehicles that dock with the International Space Station.[99] While Article VI(2) of the Draft Convention calls for such compatibility of spacecraft, it does so with soft language that merely requires parties to "study and exchange information on possible steps to ensure the compatibility of manned space objects."[100] It would be preferable to draft stronger language that would require parties to comply with a specific design standards, such as the Common Berthing Mechanism, or a variable standard that is determined by an international working group formed by a treaty for the express purpose of developing such standards.

Apart from the challenge of determining what substantive changes should be made to the current law regarding rescue and return, there is also the question of how best to go about making these changes. One possibility is to amend the Rescue Agreement pursuant to the amendment procedures set forth in Article 8 which states that (1) any State may propose an amendment and (2) any proposed amendment shall enter into force upon the acceptance of the amendment by a majority of States that are party to the Rescue Agreement (but shall only bind those States that accept the amendment).[101] However, this procedure sets a high bar for modifying the law since it would require the assent of forty-five countries – a task that would likely take many years to achieve before even a single country

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[99] Richard J. McLaughlin & William H. Warr, *The Common Berthing Mechanism (CBM) for International Space Station*, SAE Int'l Doc. 2001-01-2435, 31st International Conference on Environmental Systems (2001), *available at* http://spacecraft.ssl.umd.edu/design_lib/ICES01-2435.ISS_CBM.pdf.

[100] MANNED SPACE FLIGHT, *supra* note 2, at 11.

[101] Rescue Agreement, *supra* note 16, at art. 8.

would be bound by the amendments. In light of this, the preferable approach would be to draft a separate agreement or protocol containing provisions that would set forth new obligations. This protocol could be drafted in a manner that referenced the Rescue Agreement and stated that the obligations under the Rescue Agreement would be modified as set forth in the protocol. More importantly, the protocol could be drafted in a manner that would allow it to enter into force upon the ratification by two or three countries, thus permitting the changes to go into effect within a short period of time. Of course, the protocol would only be binding on those states that ratified it and it might still take many years before broad ratification were achieved – but at least there would be rather immediate implementation of the changes with respect to those countries that ratified the protocol early on.

V. CONCLUSION

Virgin Galactic and the other space tourism companies will be pioneers in the next era of human spaceflight. In the early phase of their operations, these companies will face many technological, financial, and regulatory challenges – but the greatest challenge overall will be ensuring the safety of their customers. Passenger safety is a multi-faceted problem that will require safe technology, the proper training of the flight crew, as well as passenger screening and training. In the event that an emergency arises during flight, the ability of a company to rescue its passengers will also be of great importance for the survival of not only the passengers, but of the company as well. In order to assist companies in providing for the safe rescue of their passengers, this article has shown that a strong argument can be made that the Rescue Agreement requires parties to the treaty to rescue space tourists. In addition, this article has shown that the Rescue Agreement requires states to recover and return private spacecraft, including spaceplanes used to ferry tourists into space.

The duty of States to rescue space tourists and return private spacecraft should be taken into account by companies as they create their contingency plans for the rescue of their customers and the retrieval of their spacecraft. While some operations, such as Virgin Galactic's suborbital flights out of New Mexico, are not likely to result in an unintended landing in foreign territory, other companies may be operating in an international environment. For example, Rocketplane's plans to launch suborbital flights from Dubai could result in unintended landings in Iranian waters. Companies, such as Rocketplane, that face the possibility of losing a spacecraft in foreign territory should consider notifying the country prior to launch regarding their duties to rescue the passengers and return the spacecraft in the event of an accident. Alternatively, a company should be prepared to demand that states adhere to their duty to rescue and return in the event that an accident takes place. This article provides the legal framework for such a demand. In the meantime, the law regarding rescue and return should be reformed as recommended herein so that in the future space tourism companies will be able to operate in a legal environment that ensures the safety of their customers and prevents the misappropriation of their spacecraft.

TOWARD IMPLEMENTATION OF THE GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS DATA SHARING PRINCIPLES*

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I. INTRODUCTION

The World Summit on Sustainable Development (WSSD) in Johannesburg in 2002 highlighted the urgent need for coordinated observations of the Earth in support of sustainable development. At the first Earth Observation Summit in Washington, DC in 2003, representatives of 33 countries, the European Commission and more than 20 international organizations affirmed the need for a comprehensive, coordinated, and sustained system of Earth observing systems and established the *ad hoc* intergovernmental Group on Earth Observations (GEO), co-chaired by the European Commission, Japan, South Africa, and the United States. In February 2005, GEO adopted the Global Earth Observation System of Systems (GEOSS) *10-Year Implementation Plan*, which establishes the intent, operating principles, and institutions relating to GEOSS [GEOSS, 2005].

The purpose and vision for GEOSS is "to realize a future wherein decisions and actions for the benefit of humankind are informed via coordinated, comprehensive and sustained Earth observations and information." GEOSS is seen as an important contribution to meeting the Millennium Development Goals and to furthering the implementation of international treaty obligations. GEOSS will encompass all areas of the Earth, with a particular emphasis on addressing the needs of developing country users. GEOSS will incorporate *in situ*, airborne, and space-based observations and address the integration of observations with models to support early warning and prediction. It is anticipated that GEOSS will focus initially on information needs in nine societal benefit areas, ranging from disaster management to sustainable agriculture to climate variability and change.

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Consistent with these goals, GEOSS also has a role in raising awareness of the need for more Earth observation efforts and in promoting better use for decision-making and in promoting societal benefits. GEOSS, as a coordinated effort, is expected to help avoid unnecessary duplication of effort, to identify major data and information gaps, and assist governments and Participating Organizations in planning new investments in the sharing of Earth observation and other related data.

The GEOSS *10-Year Implementation Plan* explicitly acknowledges the importance of data sharing in achieving the GEOSS vision and anticipated societal benefits. The Plan, endorsed by nearly 60 governments and the European Commission at the Third Earth Observation Summit in Brussels, highlights the following GEOSS Data Sharing Principles:

1. There will be full and open exchange of data, metadata, and products shared within GEOSS, recognizing relevant international instruments and national policies and legislation.

2. All shared data, metadata, and products will be made available with minimum time delay and at minimum cost.

3. All shared data, metadata, and products being free of charge or no more than cost of reproduction will be encouraged for research and education.

All new members of GEO are required to endorse the Plan and therefore these Principles. The Plan notes that "use of data or products does not necessarily imply agreement with, or endorsement of the purpose behind the gathering of such data."

In 2006, GEO established Task DA-06-01, "Furthering the Practical Application of the Agreed GEOSS Data Sharing Principles," and invited GEO Members and Participating Organizations to help implement the task. The International Council for Science (ICSU), working through its interdisciplinary committee, the Committee on Data for Science and Technology (CODATA), agreed to lead this task, under the auspices of the GEO Architecture and Data Committee. In October 2006, in conjunction with the 20th International CODATA Conference in Beijing, CODATA convened a meeting of experts to discuss the data sharing task and associated implementation issues [see:

http://www.codata.org/GEOSS/DA-06-01MeetingBeijingOct2006 review.pdf]. This meeting provided important inputs into the structure and content of this *White Paper and Implementation Guidelines for the GEOSS Data Sharing Principles*.

Following the experts meeting, CODATA developed an international team of authors and reviewers to draft and refine the White Paper, and to coordinate its activities with various GEO Committees and the GEO Secretariat. The names of the individuals on the drafting and review groups, as well as of other experts who have contributed to the White Paper are provided in Appendix A. It should be noted that all the authors and contributors involved in this activity did so in their personal capacities and not as representatives of their employing organizations. The References supporting the analysis in this report are provided in Appendix B. The White Paper was also formally reviewed by representatives of many GEOSS Members, Participating Organizations, and Committees in the summer of 2007, and by the Architecture and Data Committee at its September 2007 meeting. The White Paper was then provided for information to GEOSS Members and Participating Organizations at the GEO Plenary and Ministerial Summit in Cape Town, South Africa in November 2007, and discussed in a side event organized by CODATA during that time. Since then the White Paper benefitted from a series of more formal reviews within the GEO community, leading to further revisions to the text. The White Paper was submitted to the GEO Plenary in Bucharest in November 2008.

GEOSS is envisioned as a "system of systems," built upon existing observational systems and incorporating new systems for Earth observation and modeling that are offered as GEOSS components by Member countries and Participating Organizations. Developing technical interoperability between such diverse systems is clearly a major challenge, but an equally important challenge is the coordination and harmonization of data policies and procedures to facilitate the sharing and use of GEOSS data to maximize societal benefits for the widest possible range of users. Inconsistent or vague data policies and procedures could hamper the rapid dissemination and flexible use of data and information needed for mission-critical and/or life-saving GEOSS applications. Restrictive policies on data reuse and re-dissemination would significantly reduce the net return on investment of public funds in Earth observations and lead to unnecessary and wasteful duplication of effort. Excessive charges for data would pose substantial barriers to many users, especially those in developing countries, who may have no or few alternative sources for data.

This White Paper reviews the background issues for implementing the GEOSS Data Sharing Principles and recommends Implementation Guidelines to ensure the strongest possible framework for data sharing, consistent with both the spirit and the "letter" of the Principles. As recognized by the *10-Year Implementation Plan*, "ensuring that such information is available to those who need it is a function of governments and institutions at all levels." It is therefore incumbent on governments and institutions participating in GEOSS to continue to develop and implement appropriate policies and procedures that enable and support the GEOSS Data Sharing Principles in fair and effective ways. The implementation approaches discussed here are intended to facilitate this process.

The long-run success of GEOSS is likely to be contingent upon the manner in which the visionary GEOSS Data Sharing Principles are implemented, both by the individual elements of GEOSS and by the GEO overall. Although it is apparent that no single set of rules will apply to all types, sources, and uses of data, a clear set of guidelines, definitions, and minimum expectations should help to improve the sharing of data within GEOSS and facilitate the application of GEOSS data by diverse users in the key societal benefit areas. Such guidelines should also provide useful inputs into the technical evolution of GEOSS, such as in the area of automated digital rights management and the development of appropriate metrics.

II. OVERVIEW OF DATA SHARING LAWS, PRINCIPLES, AND POLICIES

A. Introduction

As the GEOSS Data Sharing Principles make clear, there is a consensus among the GEOSS Members and Participating Organizations that data, metadata, and products that they make available through GEOSS need to be shared and exchanged on a "full and open" basis, with minimum time delay and minimum cost. "Full and open exchange" has been defined as "data and information derived from publicly funded research are made available with as few restrictions as possible, on a nondiscriminatory basis, for no more than the cost of reproduction and distribution" [NRC, 1997]. This definition is adapted from a principle for access to data from global change research that was first articulated as part of the U.S. Global Change Research Program [OSTP, 1991]. The cost of reproduction and distribution, or the marginal cost of fulfilling a user request, on the Internet is either very small or zero. This policy has been used in various international and national environmental projects and in environmental (and other) research over the past two decades. Although intended primarily for data from publicly-funded research, the policy as defined can have broad applicability to other types of public data relevant for inclusion in the GEOSS data system. Moreover, there is an emerging international consensus that openness as the default rule for government data and information—free online and unrestricted in its use—provides the greatest return on the public investments in them and serves the public interest.

At the same time, the diversity of data and data sources expected to be made available through GEOSS makes data sharing difficult and uncertain in various contexts. Different data policy frameworks have evolved for different types of data, including research versus operational data, space-based versus *in situ* data, and data collected by public versus private organizations. Nations have developed different approaches to the ownership and use of publicly generated or funded data. When "raw," that is unprocessed, data are transformed into value-added data and information, differing intellectual property laws may be applicable. Divergent policies may also apply to data used in legal or regulatory processes (i.e., electronic records) versus data collected for other purposes such as scientific research.

Further, the sharing of GEOSS data will in some cases be subject to important exceptions such as the protection of national security, privacy and confidentiality, indigenous rights, and threatened ecological and cultural resources. By "recognizing relevant international instruments and national policies and legislation," the Data Sharing Principles clearly allow for exceptions to "full and open exchange of data, metadata, and products shared within GEOSS." Good faith efforts to limit the scope and application of exceptions are necessary to avoid the development of a complex patchwork of rules that will inhibit desirable uses of data and that will, in the end, fail to provide the desired protections.

Because of the very broad scope of potential GEOSS data and their applications there are many international and national laws, principles, and policies that may be applicable. This chapter begins by examining the variety and complexity of those authoritative sources, with particular focus on policies that promote the open availability, or full and open exchange of data relevant to GEOSS. The underlying rationales for making the data as broadly shared and with the least number of restrictions are then presented, dividing the issues between data that are generated by governments, by other entities with a mix of public and private funding, and by the private sector. Particular attention is devoted to the special status of research, educational, and developing country users. The chapter concludes with an overview of the various legal and policy exceptions to data sharing, which must be taken into account by the contributors to the GEOSS data system.

B. International and Regional Sources of Law, Principles, and Policies

The sources of laws, principles, policies, and definitions of key terms that are relevant to the GEOSS Data Sharing Principles are summarized in this section. They are presented roughly in the order of their importance to topic; that is, from international to regional to national, from specific to general, and in terms of their legal and normative effect.

It is difficult to cover all of the international sources of law, principles, and policies that have some relevance to GEOSS data sharing. These include intellectual property treaties and other types of conventions that carry the greatest legal force and binding commitments for the signatories; international remote sensing principles and policies; United Nations resolutions and declarations; the policies of UN Specialized Agencies and other intergovernmental organizations; public international data system and research program policies; and many regional agreements, laws, and policies, notably within the European Union. These may be characterized in two broad categories: those that are directly relevant to the subject matter areas of the GEOSS data sources and those that address broader information law and policy principles. The examples provided below are not comprehensive, but are intended to identify some of the more important sources of policy in support of the GEOSS data sharing principles.

1. Treaties

There are numerous treaties that cover data and information rights or data sharing obligations or restrictions in specific geographic or subject matter contexts. The various intellectual property conventions are especially important. Copyright treaties [e.g., WIPO Berne Copyright Convention, 1976, and WIPO Copyright Treaty, 1996] and their national legislative implementations (UNESCO, 2004) treat rote, factual compilations that lack creativity or originality in their selection or arrangement, particularly raw data streams, as not copyrightable. The data in those databases are in the public domain and can be used and shared freely, once lawfully accessed. However, as data become more processed and have added value, they may become protectable under copyright law, depending on the particular jurisdiction.

Treaties concerning the environment—the Antarctic Treaty, Convention on the Law of the Sea, Ozone Protocol, Convention on Biodiversity, and the Aarhus Convention, to name but a few that have a strong connection to GEOSS—have various data and information access and sharing provisions as well. To the extent that nations participating in GEOSS are also parties to these various treaties, the agreements impose binding commitments on them with regard to the data gathered and used in those contexts.

2. International remote sensing principles, policies, and definitions

Many, but by no means all, sources of GEOSS data will be from various remote sensing satellite systems. At the global level, there are three main sources of remote sensing data principles and policies relevant to GEOSS: the *UN Principles Relating to Remote Sensing of Earth from Space* (UN Remote Sensing Principles; UNGA, 1986); the international *Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters* (Charter on Space and Disaster Cooperation; International Charter, 2000); and two sets of principles developed by the Committee on Earth Observation Satellites (CEOS). The CEOS Principles are the *Satellite Data Exchange Principles in Support of Global Change Research* (CEOS Global Change Principles; CEOS, 1991), plus a 1992 elaboration; and the *Satellite Data Exchange Principles in Support of Operational Environmental Use for the Public Benefit* (CEOS Public Benefit Principles; CEOS, 1994). These principles apply to all civil government remote sensing satellite data and some nations interpret and apply the principles to private system data as well. Although these international instruments do not have the binding force of law on the parties to GEOSS as do treaties and national legislation, they provide some of the most directly relevant guidance and normative values to the implementation of the GEOSS Data Sharing Principles, as well as useful definitions of key terms.

The UN Remote Sensing Principles. These are the first and foundational source of policy guidance for remote sensing activities. They are contained in a 1987 General Assembly Resolution and cite provisions of the 1967 Outer Space Treaty. That treaty mandates that outer space is the "province of all mankind" and requires that the exploration and use of space be for the benefit of all nations, regardless of their degree of economic or scientific development (UN, 1967).

The UN Remote Sensing Principles address access and distribution of data and information generated by civilian remote sensing systems. "Primary data" are defined as the raw data delivered in the form of electromagnetic signals, photographic film, magnetic tape, or any other means. "Processed data" are the products resulting from processing primary data, and analyzed information means information resulting from interpreting processed data. "Remote sensing activities" include operations, data collection, storage, processing, interpretation, and dissemination.

The UN Remote Sensing Principles set a standard of international cooperation among states operating remote sensing systems (sensing states) and states whose territory is being observed (sensed states), while attempting to achieve a balance between the rights and interests of both groups. On the one hand, sensing states agree to avoid harm to sensed states and to provide them with access to primary data and processed data concerning their own territory on a nondiscriminatory basis. Analyzed information available to sensing states is also to be available to the sensed states on the same basis and terms. On the other hand, sensed states are required to pay reasonable cost terms and do not have access to analyzed information that is otherwise not legally available to them (e.g., proprietary information).

The needs of the developing nations, however, are to be given special regard. Sensing states are encouraged to provide cooperative opportunities to such nations in a wide array of activities, ranging from data collection to establishing and operating storage stations and processing facilities. If requested, a sensing state must consult with a sensed state to make available opportunities for participation. Regional agreements are preferred wherever feasible.

The UN Remote Sensing Principles specifically promote protection of the Earth's environment and of humanity from natural disasters. States participating in remote sensing activities that possess information useful for averting harmful phenomena are required to disclose the information to concerned states. If the potential harm threatens people, the obligation to disclose such information requires promptness and extends not only to the primary data, but to processed data and analyzed information.

The Charter on Space and Disaster Cooperation. Following the 1999 UNISPACE III conference held in Vienna, the space agencies of some major space faring countries initiated the international Charter on Space and Disaster Cooperation, which was later opened to a number of other types of participating organizations. The agreement became operational in 2000. It authorizes a broad range of participants beyond Nation-States to enable pragmatic responses to a disaster by the entities most qualified to do so, such as, rescue and civil protection, defense and security, or other services. A "disaster" includes natural and technological causes. Resources that are to be made available under the Charter include data, information, and facilities. There are definitional differences for "data" and "information" in the Charter as in the UN Remote Sensing Principles. In the Charter "space data" are narrowly defined as "raw data gathered by a space system," controlled or accessed by a party, and transmitted or conveyed to a ground station. "Information" is data that have been corrected and processed by the parties using an analysis program, in preparation for crisis management use by associated bodies to aid beneficiary bodies. Information "forms the basis for extraction of products on location." The Charter on Space and Disaster Cooperation and the UN Remote Sensing Principles also reinforce each other: the purpose of the Charter is to serve populations in great distress from a disaster involving loss of human life caused by a natural phenomenon (or a technological source), while the UN Remote Sensing Principles promote protection of the environment and human life from natural disasters. The Charter's purview goes beyond remote sensing systems by defining "space facilities" as consisting of a wide range of functions, including space systems for observation, meteorology, positioning, telecommunications, and TV broadcasting.

The CEOS Global Change Principles. These Principles affirm the value of investments made by governments and international organizations in Earth observation programs, and that both data providers and users should respect these investments. They also recognize the importance of using appropriate legal mechanisms for the exchange of remotely sensed data. The principles are as follows: global change research requires the preservation of data and easily accessible archives that include information for locating and obtaining data; the greatest use possible of international standards for storing, recording, processing and communicating data; maximizing satellite data use is a "fundamental objective" which requires the "first step" of exchange and sharing mechanisms; nondiscriminatory access is "essential"; there should be no exclusive periods of use for programs except for validations; and priorities for acquisition, archiving and purging should be harmonized. The CEOS Global Change Principles also urge the signatories to adopt the following practices: data suppliers should submit standard product catalogs; international research programs should identify data requirements; researchers need to be chosen through peer review; and written agreements (including the protection of data rights and requirements for publication) need to be signed by selected researchers and their sponsoring institutions; and data must be shared [at a minimum] among selected users.

The CEOS Public Benefit Principles. This document specifically anticipates the emerging operational requirements for global Earth observing systems. The principles apply to satellite, *in situ*, and airborne data and focus on data acquisition, processing, and other functions as they relate to operational environmental use for the public benefit. Both real time and archived data should be available on time scales compatible with user requirements; data suppliers should supply metadata; commons standards should be used to the greatest extent possible for recording, storing, processing, and communicating data; there should be no exclusive periods of data use, except for validation and the limited period should be limited and explicitly defined. "Nondiscriminatory" is defined as "all users in a clearly defined category" who "obtain data on the same terms and conditions." "Real time" is defined as "making data available by direct broadcast or immediately after acquisition and/or initial processing."

3. United Nations Declarations and Resolutions

The provision of broad access to environmental data about the Earth has a high scientific, technological, and political profile within the United Nations system and in other major fora. Notably, the World Summit on Sustainable Development (WSSD), held in Johannesburg in 2002, and recent meetings of the G8 Ministers have emphasized the need for the international community to monitor the environment, improve our knowledge and understanding of environmental processes and be able to predict future changes. At the WSSD, the participating nations issued a Declaration that recognized the need to support "the exchange of observations recorded from *in situ*, aircraft, and satellite networks, dedicated to the purposes of this Declaration, in a full and open manner with minimum time delay and minimum cost, recognizing relevant international instruments and national policies and legislation" [UN, 2002].

The concern for access to public information, in general, and to environmental information, in particular, was also recognized in the World Summit on the Information Society in 2003: "the sharing and strengthening of global knowledge for development can be enhanced by removing barriers to equitable access to information for economic, social, political, health, cultural, educational, and scientific activities and by facilitating access to public domain information, including by universal design and the use of assistive technologies" [WSIS, 2003].

The United Nations Educational, Scientific, and Cultural Organization's (UNESCO) Recommendation Concerning the Promotion and use of Multilingualism and Universal Access to Cyberspace [UNESCO, 2003], also strongly encouraged government bodies in Member States to "develop public domain content" and provided guidance on the implementation of that objective.

4. Policies of UN Specialized Agencies and other intergovernmental organizations

The UN Specialized Agencies, such as the World Meteorological Organization (WMO), the World Health Organization (WHO), the United Nations Environment Programme (UNEP), and UNESCO, among others, have a variety of data programs and policies, some of which provide broad international access to that information. CODATA has a compilation of many of these intergovernmental and international organization policies through the year 1999 available online at http://www.codata.org/data_access/policies.html.

For example, the WMO's World Weather Watch pools meteorological data from around the world and makes it broadly available. WMO Resolution 40 is an important data policy to which many GEOSS Members adhere and is worthwhile to reproduce in relevant part here:

> As a fundamental principle of the World Meteorological Organization (WMO), and in consonance with the expanding requirements for its scientific and technical expertise, WMO commits itself to broadening and enhancing the free and unrestricted [see definition below] international exchange of meteorological and related data and products;
>
> Adopts the following practice on the international exchange of meteorological and related data and products:
>
> (1) Members shall provide on a free and unrestricted basis essential data and products which are necessary for the provision of services in support of the protection of life and property and the well-being of all nations, particularly those basic data and products, as, at a minimum, described in Annex 1 to this resolution, required to describe and forecast accurately weather and climate, and support WMO Programmes;
>
> (2) Members should also provide the additional data and products which are required to sustain WMO Programmes at the global, regional, and national levels and, further, as agreed, to assist other Members in the provision of meteorological services in their countries. While increasing the volume of data and products available to all Members by providing these additional data and products, it is understood that WMO Members

may be justified in placing conditions on their re-export for commercial purposes outside of the receiving country or group of countries forming a single economic group, for reasons such as national laws or costs of production;

(3) Members should provide to the research and education communities, for their non-commercial activities, free and unrestricted access to all data and products exchanged under the auspices of WMO with the understanding that their commercial activities are subject to the same conditions identified in Adopts (2) above; Stresses that all meteorological and related data and products required to fulfil Members' obligations under WMO Programmes will be encompassed by the combination of essential and additional data and products exchanged by Members;

Urges Members to:

(1) Strengthen their commitment to the free and unrestricted exchange of meteorological and related data and products;

(2) Increase the volume of data and products exchanged to meet the needs of WMO Programmes;

(3) Assist other Members, to the extent possible, and as agreed, by providing additional data and products in support of time-sensitive operations regarding severe weather warnings;

(4) Strengthen their commitments to the WMO and ICSU WDCs in their collection and supply of meteorological and related data and products on a free and unrestricted basis;

(5) Implement the practice on the international exchange of meteorological and related data and products, as described in Adopts (1) to (3) above;

(6) Make known to all Members, through the WMO Secretariat, those meteorological and related data and products which have conditions related to their re-export for commercial purposes outside of the receiving country or group of countries forming a single economic group;

(7) Make their best efforts to ensure that the conditions which have been applied by the originator of additional data and

products are made known to initial and subsequent recipients. (see: http://www.wmo.ch/pages/about/Resolution40.html)

In the context of WMO Resolution 40, "free and unrestricted" means non-discriminatory and without charge [Resolution 23 (EC-XLII) — Guidelines on international aspects of provision of basic and special meteorological services]. "Without charge," in the context of this resolution means at no more than the cost of reproduction and delivery, without charge for the data and products themselves.

Similarly, UNESCO's Intergovernmental Oceanographic Commission's (IOC) Data Exchange Policy states that all IOC Member States shall provide timely, free, and unrestricted access to all data, associated metadata and products generated under the auspices of IOC programs [IOC, 2002]. The IOC also has a specialized program for oceanographic data and information management, the International Oceanographic Data and Information Exchange (IODE), which was established in 1961. It now has 65 national oceanographic data center members that adhere to the IOC Data Exchange Policy.

An important regional organization is the European Meteorological Services (ECOMET), whose data policy has been designed to fully comply with the WMO Resolution 40 and the European directive on the re-use of public sector information. ECOMET is a grouping of 23 national meteorological services in Europe. It has been in operation since 1995 and is still growing with the recently joined European member states. See www.ecomet.eu, where the principles and the benefits of ECOMET are explained.

Also important are the recent OECD Principles and Guidelines on Access to Research Data from Public Funding [OECD, 2007], which identify a number of guiding principles for managing such data. This document, adopted by consensus by the OECD Member States, identifies "openness" as the first principle and default rule for data access from publicly funded research. Openness is defined as "access on equal terms for the international research community at the lowest possible cost, preferably at no more than the marginal cost of dissemination."

5. Public international data system and research program policies

There are several major public international research and data systems that have open access and unrestricted reuse policies. The oldest and perhaps the best known is the World Data Center (WDC) system that was established following the International Geophysical Year (IGY) of 1957. The IGY achieved outstanding success in promoting cooperation among nations to gather, preserve, and make openly available scientific data and information about the Earth and its space environment. Many of the features that are considered part of open access data policy were initiated through the IGY and implemented through the WDC system, making it a highly relevant model for the GEOSS initiative and its data sharing activity.

Many other public international research and data activities have followed, especially in more recent years. Notable examples include the World Climate Research Program, the International Geosphere-Biosphere Program, the International Polar Year, the electronic Geophysical Year, and the Global Biodiversity Information Facility, among many others. These cooperative research and data sharing activities endeavor to make the data contributed into their data systems and served through their online portals openly and freely available, with no restrictions on reuse. The policies of such international research programs through the year 1999 are available at: http://www.codata.org/data_access/policies.html.

6. Regional laws and policies

By far the most prolific implementation of regional laws and policies regarding data access and reuse has been in the European Union (EU). Particularly important in the GEOSS context are the Directive on re-use of public sector information [CEC, 2003] and the Directive on public access to environmental information [CEC, 2003]. The PSI Directive encourages public-sector entities to facilitate re-use and not charge more that the marginal cost of fulfilling a user request, although these principles are not mandated. The Directive on Environmental Information is more prescriptive and requires Member States to make public environmental data and information freely available to users at the source and encourages reasonable pricing externally. It also prohibits re-use restrictions on such data and information. Appendix C, contributed by Katleen Janssen, provides a compendium of some of the other most important examples.

C. National Laws and Policies Concerning Public Data Access

National laws mostly track the international sources described above. However, they are much more voluminous and varied, and in some cases add many details and nuances that are not found in the international instruments, while in other cases, particularly in the less economically developed countries, may not be implemented at all. The two sub-sections below provide only coarse overviews of the national sources in the different categories of data.

1. National laws and policies concerning access to Earth observation data

All space based, non-military remote sensing activities are based on the starting presumption that data are to be made available, particularly to sensed states, on a nondiscriminatory basis and that data should be as openly available as possible. Data denial is the exception, not the rule, although the principle of full and open exchange is not a universal norm. Regarding high-resolution remote sensing data, however, the number of exceptions to the nondiscriminatory access policy is growing due to national security concerns, as discussed further in section II.E.1.

In general, remote sensing states claim to follow the 1987 UN Remote Sensing Principles and incorporate them, or parts of them, in national laws. Although the actual legislative and regulatory implementations vary broadly from country to country and are too numerous to discuss in the body of this report, a comprehensive survey by Prof. Joanne Gabrynowicz of national remote sensing data laws and policies is summarized in Appendix D. Some nations also have laws and policies relating to data overall (see the next sub-section), in which remote sensing data are included.

2. Other national laws and policies relevant to GEOSS data sharing

Of particular importance to the inclusion of national or nationally acquired data into the GEOSS data system are the laws and policies that govern access to the various sources of geospatial data within each nation. All countries with remote-sensing capabilities and almost all other nations have one or more geospatial data repositories. The data access and reuse policies for these data sources vary from free access and unrestricted reuse, to availability at commercial prices and highly restrictive reuse, to conditions of state secrecy and availability only to authorized individuals with national security clearances. It is the data that can be shared from these data centers that will most likely form much of the initial contributions to the GEOSS data system.

Finally, another highly relevant set of laws and policies arises in the context of access to and reuse of government data and information. The overall public information of each country is broadly indicative of its willingness to participate fully in GEOSS and implement the Data Sharing Principles.

D. Policy Rationale for the GEOSS Data Sharing Principles

1. Introduction

As the preceding overview of laws and policies related to public data indicates, a patchwork of supportive international instruments and national policies and legislation already exists. Indeed, there are many compelling reasons for developing more comprehensive access regimes for all types of government data at the institutional, national, and international levels, with openness as the default rule [Uhlir & Schröder, 2007]. In many instances, the same or similar rationale may be extended for publicly funded data produced outside government, especially in academic and not-for-profit organizations, although some important distinctions apply.

This section examines the underlying policy rationales for various aspects of the GEOSS Data Sharing Principles. The key principles of the GEOSS data policy addressed below are: (a) the full and open access to data and [also] information (i.e., metadata and data products) shared through GEOSS, including minimum restrictions on reuse and re-dissemination and minimum costs; (b) special consideration to research, education, and developing country users; and (c) the availability of all shared data and information with minimum time delay.

2. Rationale for full and open exchange and sharing of publicly generated data and information

The arguments in favour of full and open access (and unrestricted reuse) as the default rule for data and information produced by governmental or public entities may be summarized as follows [Uhlir, 2004]:

Legal considerations. Both the activities that the government undertakes and the information produced by it in the course of those activities are a public good, properly in the public domain [Kaul *et al*., 1999]. Data produced through public investments, especially those that are relevant to the nine GEOSS societal benefit areas, frequently have global public-good characteristics [Dalrymple, 2003].

Socio-economic considerations. Because the value of data depends on their use, open access online is the most efficient way to disseminate public data and information online in order to maximize the value and return on the public investment in their production [Stiglitz *et al*., 2000]. There are numerous economic and societal benefits, both direct and indirect and frequently on an exponential basis as a result of "network effects," that can be realized through the open dissemination of public-domain data and information on the Internet [CEC, 1999 and 2001; PIRA International, 2000; Weiss, 2003; Dekkers et al, 2006; OECD, 2006; Mayo and Steinberg, 2007]. Conversely, the proprietary commercialization of public data on an exclusive basis produces *de facto* public monopolies that have inherent economic inefficiencies and tend to be contrary to the public interest. This is particularly true of data in GEOSS that provide unique or historical information about the environment that cannot be obtained after the fact, or that are too expensive and inefficient to collect independently [NRC, 1999].

Ethical considerations. The public has already paid for the production of the information. The burden of fees for access falls disproportionately on the poorest and most disadvantaged individuals, including those in developing countries and not-for-profit researchers and educators, when the information is made available online. This is an important consideration for public, governmental data, such as those relevant to the nine societal benefit areas of GEOSS, which constitute a global public good and are properly in the public domain [Longworth, 2000].

Good governance considerations. Transparency of governance is undermined by restricting citizens from access to and use of public data and information created at their expense and on their behalf. Rights of freedom of expression are compromised by restrictions on reuse and re-dissemination of public information. It is no coincidence that the most repressive political systems make the least amount of government information, especially factual data, publicly available.

By agreeing to the GEOSS Data Sharing Principles, the data system operators allow those data, metadata, and products that they contribute to GEOSS to be shared under clear, predefined terms, consistent with the principle of full and open data exchange. The users of GEOSS data need the flexibility to reuse and re-disseminate resulting data products in order to maximize not only their own uses of the data, but the secondary applications of broad benefit to the world. For example, data and information needed for immediate humanitarian assistance after a natural disaster may also be vital to recovery and reconstruction efforts that are undertaken by a wide variety of both governmental and nongovernmental organizations. Users therefore need to be able to integrate, reuse, and re-disseminate data and information with minimal restrictions in order to achieve the best results in all of the GEOSS societal benefit areas and objectives. By encouraging all publicly funded contributors of GEOSS elements to provide full and open access to their data and information, without reuse or re-dissemination restrictions, GEO will ensure the critical mass of data and information needed to make GEOSS an invaluable resource to the world.

Moreover, for GEOSS to achieve its desired vision and remain consistent with its Data Sharing Principles, the costs of using the data from the system need to be free, or as low as possible, for the widest possible range of users. In particular, metadata (descriptive documentation of the primary data set) should be made available openly at no cost, to enable users to discover sources of data and information without restriction. Metadata are essential to making GEOSS function effectively as a system of systems and to ensuring that all GEOSS data, products, and services are fully accessible on a non-discriminatory basis to all users. Charging for access to metadata would constrain many potential users from discovering useful data and information that might be of significant value to them.

Therefore, the basic presumption of GEOSS should be that Member States and other Participating Organizations are willing to develop, implement, and integrate their GEOSS components using their own resources. These organizations should recognize that they receive direct and indirect benefits from participating in the system, such as the ability to seamlessly integrate their own data with data provided by a range of other sources.

3. Data sharing considerations for data produced by entities with a mix of public and private funding

A diverse panoply of data, much of which could be relevant for inclusion in GEOSS, is produced by many different types of organizations and sectors outside government, but with government funding. Here the mixture of public and private funding with different and sometimes conflicting motivations and uses makes generalizations about data policies and principles difficult.

The issues raised in public-private relationships take many forms and contain some inherent tensions, such as openness versus exclusivity, public goods versus private investments, public domain versus proprietary rights, and competition versus monopoly, among others [Uhlir & Schröder, 2007]. This mix of motivations, priorities, and requirements is context-dependent, typically unique to the parties involved, and frequently not well-served by inflexible statutory and regulatory intellectual property frameworks. In such cases, the ordering of the respective rights and interests of the parties involved is most efficiently accomplished through voluntary agreements under private law. Private contracts or licenses provide maximum flexibility within the larger statutory and public policy context. What is especially important to emphasize here is that such agreements can in many cases provide for conditionally open access that advances the public interest goals associated with the public funding, while effectively protecting existing proprietary private interests [Reichman & Uhlir, 2003].

At the most basic level, it is possible to provide free access to data products for not-for-profit research, educational, or developing-country users, while restricting commercial users and uses to a reimbursable, or even for-profit, basis. A number of common-use licenses have been developed by the Creative Commons organization that can be especially appropriate for making such distinctions between users and uses for copyrightable data products (such as images) in a voluntary and flexible manner, with legal certainty provided by contract and enforced through intellectual property statutes [see www.CreativeCommons.com].

Various techniques of price discrimination and product differentiation may be similarly employed, based on factors such as time (e.g., real-time access for commercial users vs. delayed access for non-profits), scope of coverage (e.g., geographic or subject matter limitations), levels of customer support or service, and other possible distinctions [NRC, 1997]. Such strategies can help promote scientifically and socially beneficial access and use, not only in the complex public-private research relationships, but even in exclusively private-sector settings.

4. Data sharing considerations for data produced by private-sector entities

The presumption for data sources emanating from the private sector is that they are proprietary, subject to commercial terms and conditions. However, at least some data from private-sector entities can meet the data sharing policy conditions of GEOSS and become part of the data system for the same reasons as discussed above.

To meet the full range of user needs identified as priorities by GEO, private-sector or hybrid public-private systems should be equally encouraged to contribute to the data and information made available to users under GEOSS. It is in the interest of all GEOSS participants to ensure that the range and use of GEOSS data continues to expand, especially in developing countries. Providing usable subsets of data, products, and services absent reuse or re-dissemination restrictions from private or public-private data systems will help demonstrate the value of the data to existing and potential users, as well as providing incentives for governments, participating organizations, or other entities to contribute new elements to GEOSS.

5. Special status of research, education, and developing country users and producers of publicly funded data

Modern science is increasingly data driven. This is especially true of Earth and environmental sciences, including global change research, which rely to a great extent on the development of comprehensive global data sets [GEOSS, 2005]. Such research frequently also requires the integration, reuse, and sharing of data from many sources [NRC, 1999].

Most countries have policies that provide special status to the research and education sectors, recognizing their essential role in social and economic development. Such policies typically provide various forms of preferential treatment, incentives, subsidies, and cost allowances to researchers, educators, and students, particularly those who are funded by the public sector. However, even the private sector may offer discounts for their products and services to these groups.

There are two basic issues here. One concerns the preferential access to data for users in research and education. The GEOSS Data Sharing Principles encourage GEOSS data providers to manage their data and information available to such users free of charge or at no more than cost of reproduction. The presumption is that users in these sectors will produce socially and economically beneficial results based on such privileged access conditions, as long as the easy access is accompanied by a concomitant absence of reuse or re-dissemination restrictions.

The other issue focuses on the access to data produced by these sectors, particularly in publicly funded government and university research and education. As has already been noted in section II.B, there are many international research programs and related data activities that provide free and unrestricted or full and open access to such research data. Such international cooperative research policies and practices have parallel examples at the national level of many countries, research programs, and disciplines. In many cases, data sharing is promoted by both official research policy (e.g., through terms and conditions of public research grants) and by the norms of many discipline communities [NRC, 1997; Reichman & Uhlir, 2003].

Because the value of scientific data lies in their use, open access to and sharing of data from publicly-funded research offer many research and educational advantages over a closed, proprietary system that places high barriers to both access and subsequent re-use. Open access to such data:

- reinforces open scientific inquiry,
- encourages diversity of analysis and opinion,
- promotes new research and new types of research,
- enables the application of automated knowledge discovery tools online,
- allows the verification of previous results,
- makes possible the testing of new or alternative hypotheses and methods of analysis,
- establishes a broader base set of data than any one researcher can hope to collect, thereby providing a greater baseline of factual information for the research community,
- supports studies on data collection methods and measurement,

- facilitates the education of new researchers,
- enables the exploration of topics not envisioned by the initial investigators,
- permits the creation of new data sets, information, and knowledge when data from multiple sources are combined,
- helps transfer factual information to and promote development and capacity building in developing countries,
- promotes interdisciplinary, inter-sectoral, inter-institutional, and international research, and
- generally helps to maximize the research potential of new digital technologies and networks, thereby providing greater returns from the public investment in research [NRC, 1997; NRC, 1999; NRC 2003; Arzberger *et al*., 2004; Uhlir & Schröder, 2007].

Such policies and practices should be reinforced and expanded by GEOSS in support of the nine societal benefit areas.

In implementing the preferential access policy for research and education application, GEO should consider several issues. First, many different types of organizations are increasingly involved in research and education in both developed and developing countries, including various commercial, for-profit organizations, nongovernmental organizations, and governmental and intergovernmental agencies. Not-for-profit academic institutions may conduct research for for-profit firms that do not release the results for public use, whereas many for-profit organizations perform research and educational activities on behalf of governments for the public good. Thus, the institutional affiliation of the user is not necessarily a good indicator of the use of GEOSS data, products, and services by the user. Instead, GEO, together with its Member States and Participating Organizations, should define the types of research and education that are to be given preferential treatment in GEOSS, e.g., publicly funded research or research that leads to openly available results. Education should at least encompass all classroom and online educational activities, but whether or not the GEO principle on research and education should apply to educational and scientific publishing is an important policy issue that the GEO community should explicitly consider.

Second, GEOSS should as much as possible inform users about the costs of the data and information they obtain, including any cost reductions provided for research and educational activities or for developing country applications. This will educate users about the costs they should expect when they move from educational and research applications to other operational applications. Tracking aggregate cost reductions for research, education, and developing country applications is also one important element in demonstrating to governments and other sponsors the continuing value of GEOSS in terms of its impact on capacity building.

And third, individuals who utilize GEOSS at reduced or no cost should be expected to provide in-kind assistance in the form of help in documenting the use and impact of data, metadata, and products received. GEOSS should take steps to make submission of qualitative or quantitative impact metrics simple, but also desirable, from a user viewpoint (e.g., as part of setting up a data subscription or notification service, or obtaining a common-use license for downloaded products). See also section IV.B.4 on metrics and indicators.

Finally, with regard to preferential policies for users in the developing world, it is important to note that the existing infrastructure for data delivery over the Internet favors users in developed countries who typically have ready access to relatively low-cost and high-bandwidth connections over those in developing countries, who have limited or expensive connectivity and who are therefore faced with higher costs of access to or delivery of data. GEO needs to work at a technical level to equalize the accessibility of data to users in developing and developed countries through cost recovery models that do not penalize uses of GEOSS data that specifically address developing country problems, or users based in developing countries. For example, since the cost of fulfilling a user order is more likely to be driven by the complexity of the order rather than the volume of data delivered, cost-recovery charges should be based on the characteristics of an order rather than the volume of data (number of bytes) delivered. Moreover, where possible, GEO members should explore ways to waive or minimize costs for developing country uses and users, such as through direct subsidies or recognition of in-kind contributions to GEOSS.

It should be emphasized that an acceptance and implementation of the basic concepts underlying the GEOSS data sharing principles would give an enormous boost to the ability of developing countries to play a much more prominent role in the GEO. To achieve this, what is important is that ever increasing volumes of freely available data in the nine societal benefit areas should begin to flow through GEOSS as soon as possible. Capacity building issues should therefore be more fully considered by the GEO Members and Participating Organizations, especially from the perspective of how data providers can be both encouraged and rewarded for making their data readily available and freely accessible.

6. The principle of minimum time delay for all data and information shared through GEOSS

The standard for "minimum time delay" for data and information shared within GEOSS will depend on the type of data and application and the need for appropriate quality control. Some types of GEOSS data applications will be contingent upon the rapid access to data, derived products, and associated services. Maximizing the potential societal benefits of GEOSS in many cases will require minimizing the time delays in providing the data and information through GEOSS to the users.

In general, operational systems deliver relatively well defined, well understood data on key environmental or other parameters. In most cases, automated quality control procedures can minimize time delays in data delivery.

For research data, time delays may need to include a limited period of quality control by the data provider. These should reflect the norms of the relevant scientific communities or data processing centers. Research data systems tend to deal with instruments or parameters that may be less well understood than those supported by operational systems, and that may be subject to more frequent or serious quality control problems. Some delay therefore may be necessary for preparation of metadata and careful quality control procedures.

In the case of the introduction of new data (e.g., from a new instrument) into an existing GEOSS component, a period of restricted access on the part of the research or instrument team may be needed. Such periods should be kept to a minimum, reflecting the normal practices of scientists and data managers responsible for similar systems or data production activities. Delayed access should be directly relevant to the preparation of metadata and quality control procedures and not to promote exclusivity for principal investigators and other personnel.

E. Legal and Policy Limitations on Data Sharing

There are strong arguments in favour of a default rule of openness for government data and information and for research and education. At the same time there are various legitimate, countervailing laws and polices that will limit full and open data exchange and sharing of government information. Specifically, there are statutory exemptions to public access and use based on national security and law enforcement concerns, the need to protect personal privacy, respect confidential information or indigenous rights, or conserve sensitive ecological, natural, archaeological, or cultural resources. In many jurisdictions, government data and information are treated as proprietary and protected by intellectual property laws and other restrictions. Government entities also should respect the proprietary rights in information originating from the private sector that are made available for government use, unless expressly exempted.

In certain circumstances, these types of data and information will generally only be considered for inclusion as discussed below. Because openness should be the default principle for the data and information made available through GEOSS by government members and participating organizations, however, these exceptions should be properly justified and interpreted as narrowly as possible.

1. National Security

There are, of course, many national space assets and other data collection systems that produce data similar to those that would be included in GEOSS, but that are classified as State secrets on national security grounds. Such data are unavailable for civilian use and therefore are not a part of GEOSS.

Two potential exceptions to this national security exception are possible, however. In some cases, military systems or hybrid military-civilian systems may establish dual-use policies to enable data access for both military and civilian uses. Such data policies may permit direct access to the data by defense entities and civilian users, including commercial entities, although the civilian users may not be able receive all of the data.

Another, more general, exception applies to retrospective or historical data that have been classified for some legally required period, but then subsequently become officially declassified and released into the public domain. For example, in 2001 Italy and France agreed to study and develop procedures jointly for degrading classified images, with the objective of lowering their level of classification, in accordance with the Agreement between the Government of the Italian Republic and the Government of the French Republic on Cooperation in the Field of Earth Observation. There also have been some instances in which imagery that was previously classified for national security purposes was declassified within a short period of time. One case of such dual use data being made openly available involved declassifying imagery of a location that had just recently been used for national security purposes [Gabrynowicz, 2002]. Another involved a review by an expert committee of old classified data sets with a view to their application for environmental research, and many data were subsequently designated for advance declassification. There are various such dual use data sources of significant relevance to GEOSS objectives that should be considered for inclusion in the system, once they are properly declassified.

Although civilian government and private-sector remote sensing systems are not classified, they may occasionally collect data that have national security implications and that may be withheld pursuant to the laws in the controlling jurisdictions. This is particularly an issue regarding high-resolution data collected by non-classified space systems. The number of exceptions to the nondiscriminatory access policy is growing in Canada, Europe (Germany, France, and Italy), India, Israel, and the United States, among others. Recent and pending legislation demonstrate that national security interests are being expanded further over general data access. Governments are engaging in what is more correctly characterized as "controlled access," rather than "restricted access" and are construing the 1987 U.N. Remote Sensing Principles more narrowly. For example, new Canadian legislation specifically contends that a sensed State's right to data of its territory is limited to data used for resource management purposes [Mann, 2006]. In recently enacted German legislation, the terms "non-discriminatory" and "reasonable" are interpreted by imposing security aspects on data distribution, and thereby restricting a sensed State's access to data of its own territory subject to Germany's security or foreign policy interests. [For a review of this legislation prior to its enactment, see Gerhard and Schmidt-Tedd, 2005. An analysis of the law as enacted can be found in Vol. 34, No. 1 of the Journal of Space Law, 2008.].

2. Proprietary Rights

The intellectual property (IP) status of data, databases, and data products is a complex legal subject, depending on the jurisdiction, the source of the data, and the level of creativity. In addition to copyright, proprietary rights can be enforced using trade secret law, unfair competition law, database protection laws (e.g., those in the E.U., such as the 1996 Directive on the legal protection of databases), and private contracts and licenses.

Some countries, such as the United States, expressly exclude government-generated information from copyright. In many other nations, public information is subject to IP protection, although this may be tempered by competing policies, such as the public's right to know and the other policy arguments in favour of openness presented in earlier sections of this chapter.

Moreover, to the extent that the public information is copyrightable, the government can make it openly available with minimum re-use restrictions by applying common-use licenses such as the Creative Commons templates.

On a spectrum with raw data at one end and a highly processed, value-added product on the other, there are varying degrees of statutory IP protection. In general, raw data produced technologically without benefit of human intellectual creativity is unprotected by copyright. More complex information such as metadata and data products that are identified in the GEOSS Data Sharing Policy, however, typically requires creativity and originality in its production, thereby making it copyrightable. Determining where to draw the line on what data, metadata, and products are protectable or not under statutory IP law can be difficult to determine and enforce, which is why most proprietary digital data and information are now protected by restrictive private-law contracts and licenses and by technological means.

Finally, as noted in section II.D.6 above, researchers typically have a proprietary period of exclusive use of data that they have collected using public funds. This period may be established by a research contract or grant for some specific period of time, such as one to three years, or disclosure may be triggered by the publication of results based on the data collection. Following publication, the data on which the results are based need to be made available so that the results can be verified [NRC 1997].

3. Personal Privacy

An important distinction must be made between data collected on human subjects and data on other, impersonal subjects. Data on human subjects are restricted in various ways on ethical and legal grounds to protect personal privacy. Internationally, the OECD issued guidelines on this topic [OECD, 1980] and the EU has strong personal privacy protections [Directive 95/46/EC on the protection of personal data, and Convention No. 108 of the Council of Europe, 1981]. Many countries also have adopted legislation and regulations that protect personal privacy at the national level. Typically, data sources that have been subjected to de-identification of personal information can be shared or made otherwise available, and these types of data may be considered for inclusion in the GEOSS data system.

4. Confidentiality

Data designated as confidential can only be transferred on a very limited, privileged basis, subject to specific contractual provisions between the data source and the recipient. Such data should not be disclosed, and certainly not shared though GEOSS.

5. Indigenous Rights

Observational data (e.g., remote sensing images or photographs) of some indigenous peoples or lands within their jurisdiction may not be either collected or shared. In other cases, data concerning traditional knowledge may not be shared or exploited commercially. Such data types that compromise legitimate indigenous rights may not be made available through GEOSS.

6. Conservation and Protection of Sensitive Ecological, Natural, Archaeological, or Cultural Resources

International treaties that protect rare species of animals and plants, such as the 1975 Convention on International Trade in Endangered Species of Wild Fauna and Flora, as well as biodiversity more generally, such as the 1992 Convention on Biological Diversity, also prohibit disclosure of information about their specific location. Such limitations are implemented and enforced through the legislation and regulations of most countries. Similarly, archeological and cultural sites and relics may be subject to statutory protection as well. Such data cannot be shared through GEOSS either, unless specific steps are taken to meet applicable legislation and regulations.

III. ILLUSTRATIVE CASE STUDIES

This section provides a selection of examples in several of the nine societal benefit areas regarding the potential implications of the GEOSS Data Sharing Principles, depending on key implementation choices. The objective is to illustrate the benefits of data sharing, as well as some of the important obstacles and problems that will most likely surface during the implementation and operation of GEOSS. Given the diversity and complexity of expected applications of GEOSS data, it is not feasible to analyze all possible situations nor to assess objectively the relative importance of different issues. Nevertheless, it is still instructive to review past experience and work through some illustrative scenarios to better understand how strong adherence to the Data Sharing Principles may be able to increase the utility and overall sustainability of GEOSS as a system.

A. Access to Real-time and Historical GEOSS Data for Rapid Humanitarian Response

Perhaps the most visible and pervasive motivation for the establishment of GEOSS is the potential for more rapid and comprehensive monitoring of natural and technological hazards, improved warning and prediction of dangerous events or episodes, and associated improvements in disaster mitigation and response. Better historical data on hazards can help improve risk assessment and planning for future hazards from local to global scales [UNDP, 2004; Dilley *et al.*, 2005; Arnold *et al.,* 2006]. Monitoring of hazardous conditions, through both satellite- and ground-based sensors, can help scientists to improve understanding and prediction of dangerous events. Governmental authorities and other organizations are able to react more quickly when dangerous situations develop. In many cases, such real-time data need to be integrated with computer simulation models to improve the predictions needed for early warning and response, e.g., when a cyclone approaches a populated coast, or weather conditions are likely to result in severe storms or wildfires. Of course, if the disaster is pervasive, communications may break down completely and no system is going to be useful if its information cannot be disseminated where it is needed.

Because time is often the most critical factor in response to hazardous events and it is important to get as many relevant data sources into GEOSS, automated access and integration of data and information from multiple systems within GEOSS is a *sine qua non*. This raises several potential scenarios: *1)* all GEOSS data have to be completely free and open; *2)* all digital rights and cost recovery issues can be addressed after the fact; or *3)* all digital rights and cost recovery issues can be established beforehand, dealt with through automated means online, and updated as appropriate.

Although as a matter of principle scenario 1 is the best option for most GEOSS data, the problem is that some proprietary or otherwise restricted data important for disaster response may not be free and open and therefore may not be accessible to GEOSS users. For example, after the 2004 South Asian tsunami, by far the most detailed imagery of damaged areas along the Indian Ocean coasts came from commercial high-resolution satellites that in many cases imposed reuse and redissemination restrictions. Use of these data by the United Nations and other humanitarian organizations had to be negotiated with the relevant sources [UN Geographic Information Support Team, personal communication, 2007]. It is obviously in the interest of the GEOSS community to ensure that the best available data needed for sound decision making are accessible through GEOSS, but delays in access and reuse of essential data in time-critical disasters should not be increased by bureaucratic negotiations.

Scenario 2, in which digital rights and cost recovery issues are addressed after the fact, poses a number of difficulties, including the likely unwillingness of data sources to make their data available through GEOSS without guarantee of cost recovery and control on use of their data. Legitimate users may also feel constrained on their use of data if they feel that they may be subject to some level of liability for their use and redissemination of data in a crisis situation.

Scenario 3 is the best available option to get proprietary or otherwise restricted data into GEOSS; that is, implementation of automated digital rights management within GEOSS to support real-time access to data and information while respecting pre-determined data usage conditions, which can be updated as appropriate. Such usage conditions should include a) clear definitions of rights and limitations in using data and disseminating derived products in humanitarian situations, b) recovery of costs in line with the GEOSS Data Sharing Principles and recommended Implementation Guidelines and c) a statement that the Implementation Guidelines are a starting point and individual Member States and Participating Organizations are free to provide data and usage rights beyond the principles and guidelines. Since digital rights will be clear in advance, users would be able to adapt their practices to ensure appropriate levels of access prior to a crisis (e.g., if they need to pre-register as a humanitarian organization).

B. Research Uses of Integrated GEOSS Data for Climate Change Impact Assessments

Recent reports by the Intergovernmental Panel on Climate Change (IPCC) have highlighted the multidimensional nature of ongoing climatic variability and predicted climate changes and the many ways in which human health and wellbeing could be affected from global to local scales [IPCC, 2007a, b, c]. Research on the impacts of climate change and potential adaptation and mitigation strategies is increasing rapidly around the world, with particular attention to possible interactions across sectors and issues, e.g., agriculture, water, energy, hazards, and health.

A major constraint on past research efforts has been the difficulty of assembling and integrating diverse data types from multiple instruments and platforms, disparate data systems, and different disciplines. The spatial coverage of measurements often varies significantly over time, and the development of reliable, consistent time series for key climatic and environmental parameters requires careful calibration, inter-comparison, and quality control. Of particular importance are inter-comparisons between remote sensing and *in situ* measurements: satellite- and aircraft-based instruments have the potential to provide data on very large areas of the globe on a regular basis to support both research and applications, but ground-based *in situ* measurements are also needed to calibrate these data and in many cases provide more detailed, frequent, long-term, and/or dense observations for specific regions of interest.

Another challenge is the need for integration of data across scientific disciplines, especially across the natural and social sciences, in order to better understand the interactions between climate and human activity and welfare. For example, it is often necessary to translate remote sensing data collected as pixels on a grid into summary statistics for administrative or political regions that can be used by social scientists or decision makers [NRC, 2002].

GEOSS offers the potential for significant improvement in coordination and quality control of data gathered from different instruments and multiple observing platforms and in providing an overall framework for rapid integration of both remote sensing and *in situ* datasets. By promoting interoperability among many different data sources and systems from around the world, GEOSS will facilitate testing and inter-comparison of measurements and increase the representation and reliability of the results. By increasing the density, frequency, and longevity of measurements, GEOSS can also facilitate more detailed, localized studies of climate change and its potential impacts.

A critical issue for the research community is not only access to relevant data, but a clear understanding of how the data were collected, what quality control procedures were utilized, and what transformation and analysis techniques were applied. A basic step in obtaining such understanding is access to appropriate metadata, i.e., documentation that describes data sources and processing. Encouraging all data providers to provide adequate metadata for their data is therefore a key priority for GEOSS. Free and open access to this metadata is then necessary to ensure that all users can discover the data they may need.

A second critical issue for both researchers and data sources is appropriate data attribution. For data providers to continue providing high quality data and metadata to GEOSS in the long term, they will need to receive appropriate recognition for the data they supply. From the viewpoint of the scientific community, being able to precisely trace data "provenance"—i.e., data sources and processing histories—is essential to the reproducibility of scientific research. From the viewpoint of commercial providers, identifying them as the data source can enhance the reputation of their products and provide a further incentive to provide access to their data.

C. Local Government Uses of High-resolution GEOSS Data for Biodiversity Conservation

Numerous, often new and dynamic, biological issues are now beginning to be addressed by local government decision makers and managers, as well as the public. Of the many new diseases (e.g., hanta virus, West Nile virus, avian flu), approximately 75 percent can affect both humans and wildlife. The number and economic impact of invasive alien species are dramatically increasing. Biodiversity is being reduced and native plants and animals are being added to the threatened and endangered list (which can dramatically restrict local development activities). There is much to be gained from conserving biodiversity, as humans depend upon plants and animals species for food, medicines, and raw materials. There is also no doubt that the beauty and variety of living species also greatly improves the quality of our lives.

There are numerous operational and economic reasons why local governments must monitor, understand, and manage local biodiversity and ecosystems. Local governments need biodiversity data to develop risk analyses and prevention plans in addressing threats to public health. Monitoring and managing/regulating land cover (including vegetation) changes in rapidly expanding urban areas are also very important.

Of the vast amount of biological data collected globally each year to study the above mentioned issues, most of it is inaccessible, because it is not digital, standardized, and/or archived with appropriate metadata. In particular, GEOSS can assist local governments around the world by providing easy access to integrated and updated biodiversity, ecosystems, and associated geophysical data and information that are critical for making informed policy and management decisions. For this particular user community, GEOSS functionality will need to combine such interdisciplinary and diverse information as Earth observations from satellites and aircraft, weather data from satellites and ground stations, historical trends from existing information, and ground observations. These integrated data sets would be used with GEOSS-developed data processing tools, as appropriate, to assess current conditions and make forecasts associated with land cover, biodiversity and ecosystem trends and associated change analyses (i.e., preferably characterizing the types, rates, and temporal and spatial variability of change; documenting driving forces; and predicting the consequences of change). In addition, GEOSS could help enable free web-based, user friendly, easily accessible, and very efficient data input, editing, analysis, visualization, and access, and provide summary statistics and analyses tailored for operational use by local governments.

GEO plans to build on and enhance existing capabilities by ensuring an operational source of existing critical data sets to drive decision support tools when needed, and integrating new data sets to enhance the performance of decision support tools and systems. Therefore, from a remote sensing perspective and for this particular local application, there also needs to be a continuing commitment to provide: 1) a global updated seasonal land cover data base at high resolution (30m; i.e., continuity of Landsat-type observations), and 2) even higher resolution (i.e., 1 to 4m) land cover enhancements and timely updates that are focused on rapidly developing/changing urban communities. Biologists, ecologists, and local natural resource managers and decision makers will also operationally need access to such additional data as: updated higher resolution topography, time series vegetation greenness, measurements of seasonal vegetation characteristics, length of growing season, onset of greenness and onset of senescence (e.g., brown-down, which are also useful in the study of and management of drought, fire, and soil moisture), estimates of soil moisture (presently using precipitation data to model and estimate soil moisture content), and volume of water bodies (which is critical for estimating the water available to local biodiversity and ecosystems).

For local communities to operationally use GEOSS data and information, the best scenario is for all GEOSS data to be completely free and open with all digital rights and cost recovery issues being dealt with in real-time through automated means by GEOSS. However, biodiversity data can be quite sensitive (e.g., location of endangered species, global species assessments, and protected areas). GEOSS could still provide such data to local communities, while respecting pre-determined data usage conditions. GEOSS may need to develop procedures to degrade or filter sensitive biodiversity data to a useful and acceptable level, or else work out an approach to sharing sensitive data in a secure mode with formal agreements between GEOSS, the data providers, and the local governments. Metadata associated with biological data (i.e., museum specimens, field notes, global species assessments) also need to be standardized and encouraged, if not required (e.g., by funding sources), as well as the consistent and timely input of these data into responsible and accessible GEOSS associated archives/servers. Local user training (i.e., available data, products, applications, and system use) also needs to be provided by GEOSS to the local government user community.

IV. IMPLEMENTATION ISSUES FOR GEOSS DATA SHARING PRINCIPLES

A. Implementation Issues

1. Alternative approaches for implementing the data sharing principles

Different approaches may be chosen for implementing the data sharing principles, ranging from formal, legal requirements established by a treaty at the international level and through legislation or administrative regulations at the national level, to much softer and less binding guidelines or ad hoc approaches. Each of these options presents some tradeoffs that the parties need to consider in advance. We suggest here that an approach that reflects non-binding, but commonly-decided guidance with respect to the data sharing principles is likely the best option for GEOSS participants to consider.

Mandated policies. One of the possible options for implementing any international activity, including data sharing, is through a mandated policy. This would require the Member

States to enter into a binding agreement, such as a multilateral treaty. During the negotiations of this convention, the Member States would come to a mutual agreement on the obligations they take upon themselves for sharing Earth observation and other GEOSS-related data. By adopting the convention and implementing the provisions through legislation and regulations at the national level, they would be accepting these obligations. Such an agreement would have to allow Participating Organizations to accede to its rights and obligations. These provisions could be modeled on those contained in the space treaties that allow participation by nongovernmental organizations.

Mandated policies may include sanctions for non-compliance, but not necessarily. However, the effectiveness would be undermined if the obligations are not taken seriously or if enforcement is lax. The biggest drawback to this option is that a mandated policy is difficult to obtain because this would take a strong commitment of all Member States and Participating Organizations and leave very little room for national or regional characteristics or customs, or provide too much restriction on the freedom and autonomy of the Member States and Participating Organizations. Indeed, GEOSS participants have already indicated that their participation is purely voluntary and non-binding, and thus any mandated policies through binding agreements are only possible if the GEOSS cooperative arrangement were renegotiated and restructured sometime in the future.

Implementation guidelines on a minimum set of commonly decided principles. Between the maximalist and minimalist implementation options outlined above, the data sharing principles can be implemented via international guidelines, adopted by consensus, that encourages, but does not mandate, adherence. Desired actions can be encouraged through education, financial assistance, technical assistance, peer influence and other inducements. The advantage of this approach is that the Member States and Participating Organizations retain their full autonomy and can implement these guidelines and practices in their national jurisdiction in whatever way they want. The disadvantage is that the Implementation Guidelines might not be fully implemented and would be less well adhered to than under a mandatory policy.

As a practical matter, however, this type of internationally decided approach could be the only one of the options that is acceptable. It is counter-productive to enforce or otherwise make mandatory anything in an environment where all contributions are voluntary or "best efforts," and where the governing body is operating in a non-legally binding manner. While the participation in and contributions to GEOSS are not legally binding, the presumption must be that the GEO Member States and Participating Organizations are taking part in good faith and will do all they can to make data sharing successful and productive .

2. Involving stakeholders and ensuring sustainability

One of the main challenges of any data sharing policy is ensuring the participation of the representatives of key stakeholder groups, who need to remain engaged on a continuous basis. The categories of major stakeholders include the data producers and users in government, academia, and industry; the public policy and funding organizations with purview over the relevant data activities; and the general public. While the involvement of the data providers is obviously crucial to obtain the GEO goal of implementing the GEOSS data sharing principles, the long-term and sustained involvement of all the other stakeholder groups is also important. Without the commitment of stakeholders across the sectors and from all the Member States, data sharing will remain an abstract principle and never become reality. The Member States and Participating Organizations should therefore be encouraged to raise awareness among their stakeholder constituencies and to continue their efforts toward participatory decision-making.

This commitment of all the stakeholders is intrinsically linked to the issue of sustainability. Operating a data collection system and then managing and making the data available requires the long-term investment of financial and human resources. As these resources are scarce and their use needs to be justified, not only for internal budget allocation within a public agency, but also towards central government and the general public, ensuring sustainability can be a struggle. Therefore it is important that funding mechanisms are elaborated and implemented in the Member States and Participating Organizations and that duplication of efforts is avoided, in order to use resources as efficiently and equitably as possible. Securing the continuous availability of resources entails involving the national policy decision makers of all the Member States and the relevant decision makers for Participating Organizations, and ensuring their understanding and endorsement of the value of GEOSS.

The motives of GEOSS participants are varied and may be driven by diverse objectives and perceived benefits. From the perspective of creating stable relationships that can sustain the GEOSS network, which incentive works best depends entirely on the context of each participant's involvement. Value is thus subjective and the network must be flexible enough to facilitate all forms of value exchange so that a participant's initial interests are met. The interdependence and reciprocity between the participant's and the network's interests needs to be sustained, if not increased.

As the most important output of GEOSS, data access and use provide a strong incentive to join the network. Because local participants can in many cases exist by serving internal or local needs with local data, motivating a member to incur the additional cost of collecting and maintaining data to serve an external, global need requires a corresponding incentive. Access to—and being a local distributor of—a global data set provides one such incentive. The participant also gains prestige as the source for a regional or global product. Additionally, the local, regional, and global data sets provide raw material for higher level value-added products. Because all forms of exchange involve local costs, value-added activities are particularly important. They provide the means to offset the costs while raising members' participation above the local level.

3. Promoting the open access ethos

In view of the vision of GEOSS to realize a future where the decisions and actions for the benefit of humanity are informed by coordinated, comprehensive, and sustained Earth observations and related data sources [GEOSS 2005], the importance of easy access and unrestricted reuse of the data cannot be overestimated. All GEOSS participants and potential participants therefore need to be made aware of the importance of the GEOSS data sharing principles. While many countries have legislation in place to provide information to their citizens, as discussed in chapter III, an effective culture of data sharing needs to be instantiated among the various GEOSS stakeholders. A strategy for promoting and enforcing the data sharing ethos is thus essential.

4. Supporting transparency

Ensuring transparency towards the citizens has a broader meaning than providing them with access to information. A democratic and transparent government allows the citizen to know and to some extent take part in the decision-making process, and to hold the government accountable for its actions. Such meaningful participation is supported by the availability of information. The sharing of data is essential for transparency of decision-making, and this transparency in turn is likely to lead to better decision-making, as the government's actions are followed by the citizens.

Obstacles to transparency include cultural factors and attitudes toward the availability of public information. Excessive official secrecy is a problem in many jurisdictions. Language is another limiting factor. Although English is the accepted language of GEOSS-related activities, not all participants understand English nor are GEOSS data and metadata routinely translated into English.

The GEOSS Data Sharing Principles and the Implementation Guidelines will support governmental transparency by promoting the availability and sharing of data and information in the nine societal benefit areas. However, the participants are encouraged to reach beyond the GEOSS data policy and guidelines and apply these principles more broadly within their public sector.

B. Incentives for Compliance with the Data Sharing Principles

1. Support of other important policy objectives

The GEOSS data sharing principles are intended to improve data access and reuse among all of the stakeholders of a well-functioning Earth observation system of systems, with particular attention to the favorable status of the research and education communities and data users in developing countries for reasons set forth in section III.C. It is essential to keep in mind that data sharing is more than a goal in itself; it is an indispensable means to reaching important policy objectives relating to health, environment, poverty, and other public-interest priorities that have been high on the global agenda for the last few decades. By improving data sharing, and the subsequent continuous availability of that information, researchers and policymakers can react with timely and well-informed decision-making to national, regional, or global issues that threaten the environment, human health, or safety.

An example that quickly comes to mind is the tsunami of 26 December 2004. A more rapid response based on shared seismic, shoreline topography, bathymetry, population, meteorology, and land-use data could potentially have saved many thousands of lives. Disaster reduction is but one of the global concerns that demand greater sharing of data from activities under the GEOSS umbrella.

Similarly, there is now broad international consensus regarding climate change based in part on human activities, resulting in some warming of the global climate over the coming decades. Responding to these changes, either through mitigation and adaptation, requires a better understanding of the natural and human-induced factors leading to those changes. The participants in GEOSS collect most of the data that are relevant to improving understanding and responding appropriately, and therefore need to make the data as broadly available for analysis as possible.

2. Credit to contributors

Sharing of data, especially online because of the potential for exponential network effects, can be much more productive with the involvement of as many stakeholders in the system as possible. Both the data producers and distributors can be encouraged or given incentives to share if they are properly credited for their contributions, not only internally within their institutions, but also externally in their communities of practice and the general public. Acknowledgement of the producers and contributors of the data, metadata, and products should be common practice within the GEOSS system. Being a part of GEOSS, sharing data with other stakeholders, and consequently improving policies on the environment or human health can provide the participants with enhanced reputational benefits and confer goodwill and appreciation from other Member States, Participating Organizations, public agencies, and the general public.

3. Digital rights management and automated online cost recovery mechanisms

A major concern of proprietary data sources, which frequently limit the access to and exchange of data, is that their data are being misused or used for different purposes than they were originally intended or authorized, leading to possible damage, liability, or infringements of intellectual property rights. One possible way to ensure that proprietary data are protected properly, but can still be shared to some extent, is through digital rights management (DRM) technologies. While DRM can have negative effects on deriving full value from the use of data, particularly data produced in the public sector, it can provide some advantages in the GEOSS data sharing context in its uses for the automatic management of data. If properly applied, it can provide clear and standard conditions for obtaining and using data, ensuring easy dissemination. In this way, it may respond to the concerns of the proprietary data sources involved in GEOSS and make them more receptive to making their data available, even if on somewhat more restrictive terms and conditions.

In particular, new methods for automated, flexible digital rights management and common-use licensing (such as Creative Commons licenses) for otherwise copyrighted data products provide the capability to manage a reasonable range of data restrictions in a rapid and seamless manner online. These methods can also help educate users about their rights, responsibilities, and restrictions regarding the data or information they obtain from GEOSS. Such approaches offer greater flexibility and the potential to promote both planned and unforeseen societal benefits than more traditional approaches that rely on technical controls, while reducing transaction costs.

Moreover, as the diversity and volume of resources and services offered by GEOSS increase, users will have more choices of data and information types and sources to address their needs. For example, they may need to choose between access to free data, which they may need to process themselves, or to value-added information or services, for which charges will most likely apply, but which can save them time or effort. They may face tradeoffs between the higher costs of high resolution data vs. free or low-cost low resolution data, between more processed quality-controlled data vs. raw data, or between real-time vs. near real-time or historic data. Some users may need to obtain data without re-dissemination or reuse restrictions, whereas others may be willing to live with restrictions in return for lower costs. To facilitate these decisions, it is important for GEO to explore implementation of online cost recovery mechanisms similar to those now common on the Internet in industry. Such systems should greatly reduce the transaction costs for cost recovery and provide users with much more detailed and accurate information on the costs of accessing alternative data and information available through GEOSS, while encouraging participation of potential GEOSS data providers, particularly from the private sector.

4. Metrics and indicators for cost/benefit analyses and evaluation of performance

As noted elsewhere in this report, a vital issue for GEOSS is its economic sustainability over the long term. This encompasses not only the ways in which specific costs for supporting the dissemination and use of GEOSS data can be shared equitably and efficiently between producers and users in developed and developing countries, but also the development of qualitative and quantitative metrics that can clearly justify continued public investment in GEOSS components and the system as a whole. Harmonization of data sharing policies regarding cost recovery, data attribution, and usage metrics could be of great value in ensuring that GEOSS will continue to receive the support it needs to function well.

There are at least two ways in which metrics can be used to promote participation in and improve the performance of GEOSS. One is through an empirical analysis of the benefits of data sharing and unrestricted reuse of data. Fact-based assessments can make a strong case in support of the GEOSS Data Sharing Principles by developing objective metrics and more subjective indicators that measure the positive economic and social effects of making data openly available and usable, especially online.

Metrics and indicators also can be valuable in encouraging GEOSS stakeholders to continue to participate and abide by the principles. Monitoring and evaluation tools can even be used to promote compliance with the policies as an enforcement tool, as discussed below, and as a means of positive attribution. The use of evaluation methods can be both expensive and onerous, however, so the costs of doing such evaluations and their actual benefits need to be carefully considered prior to implementation.

Finally, because a key objective of GEOSS is to provide integrated GEOSS data and information from multiple sources to users as quickly and seamlessly as possible, it is vital that GEOSS develop straightforward methods for assessing usage and the results of that use. This will enable GEOSS to report on usage and impact to GEOSS components, which in turn can use these metrics to justify continued operations, system improvements, and/or specific subsidies for research, education, and developing country applications.

Toward this end, GEO Members and other sponsors and participants in GEOSS will need statistical information on the volume and diversity of data and information delivered by

GEOSS, on the services rendered for users, and on the user community itself. But equally important will be metrics and indicators, both quantitative and qualitative, which characterize the impact of GEOSS across, at a minimum, the nine societal benefit areas. Planning for such assessments in a systematic manner at an early stage, while difficult, will help GEOSS evolve more quickly and effectively.

5. Peer pressure

In general, the potential embarrassment of being caught violating rules, not complying with guidelines, or simply not contributing a "fair share" is a strong motivation for compliance, particularly in small communities of practice where many of the stakeholders are known to each other. When Member States, Participating Organizations or public agencies see that their peers are complying with the data sharing principles and are achieving the desired results, they will be inclined to follow these examples. This will especially be the case if the general public is aware of these good examples and is demanding that their Member State, a Participating Organization, or public agencies do the same. No Member State or Participating Organization wants to be considered as the "weakest link in the data chain," or to be labeled as being less interested or unwilling to share its data with other stakeholders in the GEOSS partnership. This also is true for helping to promote sharing norms among data users, or conversely assisting in compliance with various applicable restrictions on uses. Nevertheless, peer pressure by itself is insufficient in most cases as a mechanism for ensuring that the stakeholders are adhering to the GEOSS norms, values, and legal rules on data sharing.

6. Developing other means for encouraging compliance by both data providers and users with the GEOSS Data Sharing Principles

Although peer pressure is important for helping to promote compliance with the GEOSS Data Sharing Principles, it is unlikely to be sufficient. Users—and the GEO purpose—will become frustrated if the exceptions start to become more prevalent than the rule. Because the GEOSS Data Sharing Principles set a high standard for data access, it is important for GEO to develop effective mechanisms and procedures to encourage GEOSS data providers to comply with the Data Sharing Principles and that any disputes about their implementation are handled as quickly and transparently as possible. GEO needs to have a way to make sure that the data providers continue to meet the established criteria for participation; otherwise, the overall "system of systems" is unlikely to attain its full potential.

Since the success of GEOSS depends to a large extent on establishing and maintaining data dissemination processes and activities founded on the agreed Data Sharing Principles, the Member States, and Participating Organizations, supported by the GEO Secretariat, therefore need to develop a comprehensive implementation plan that is consistent with the Principles and related Implementation Guidelines. This will require consultation with all major GEOSS stakeholder groups and continuing outreach efforts.

Similarly, users need to abide by the agreed terms and conditions on use of the GEOSS data providers, consistent with the Data Sharing Principles. Appropriate sanctions on users who do not respect the data providers' terms and conditions need to be developed by the GEOSS Members and Participating Organizations, and may include a variety of sanctions.

APPENDICES

APPENDIX A

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APPENDIX B

References

Arnold, M., R.S. Chen, U. Deichmann, M. Dilley, A.L. Lerner-Lam, R.J. Pullen, and Z. Trohanis, eds. (2006), "Natural Disaster Hotspots: Case Studies," The World Bank.

Arzberger, P., P. Schröder, A. Beaulieu, G. Bowker, K Casey, L. Laaksonen, D. Moorman, P. Uhlir, P. Wouters (2004), "Promoting Access to Public Research Data for Science, Economic, and Social Development," *Data Science Journal*, CODATA, available at: **http://www.jstage.jst.go.jp/article/dsj/3/0/135/_pdf**.

Commission of the European Communities (CEC) (2005) DIRECTIVE 2003/4/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC," (L 41/26), available at: **http://eur-lex.europa.eu/LexUriServ/site/en/oj/2003/l_041/l_04120030214en00260032.pdf**.

CEC (2003), "DIRECTIVE 2003/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 November 2003 on the re-use of public sector information," (L 345/90), available at: **http://ec.europa.eu/informationsociety/policy/psi/docs/pdfs/directive/psi_directive_en.pdf**.

CEC (2001), "*e*Europe 2002: Creating an EU Framework for the Exploitation of Public Sector Information," Brussels, Belgium, 23.10.2001 COM (2001) 607 final, available at: **http://www.cordis.lu/econtent/psi/psi_policy.htm**.

CEC (1999), "Public sector information: a key resource for Europe," available at: **http://www.cordis.lu/econtent/publicsector/greenpaper.html**.

Commission on Intellectual Property Rights, United Kingdom (2002), "Integrating Intellectual Property Rights and Development Policy," available at: **http://www.iprcommission.org/text/documents/final_report.htm**.

Committee on Earth Observation Satellites (CEOS) (1991, 1992), "Satellite Data Exchange Principles in Support of Global

Change Research, available at: **http://www.ceos.org/pages/satellite_1.html**.

CEOS (1994), "Satellite Data Exchange Principles in Support of Operational Environmental Use for the Public Benefit," available at: **http://www.ceos.org/pages/satellite_2.html**.

Section 1.01 Council of Europe (1985), "Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data," Strasbourg, 28.I.1981, available at: **http://conventions.coe.int/Treaty/en/Treaties/Html/108.htm**.

Section 1.02 Dalrymple, Dana (2003), "Scientific Knowledge as a Global Public Good: Contributions to Innovation and the Economy," in NRC (2003), available at: **http://books.nap.edu/openbook.php?record_id=10785&page=35**.

Dekkers, Makx, Femke Polman, Robbin te Velde, and Marc de Vries (2006), "Measuring European Public Sector Resources," HELM Group and Zenc, 56 p. plus Appendices, available at: **http://ec.europa.eu/information_society/policy/psi/docs/pdfs/mepsir/final_report.pdf**.

Dilley, M., R.S. Chen, U. Deichmann, A.L. Lerner-Lam, M. Arnold with J. Agwe, P. Buys, O. Kjekstad, B. Lyon, and G. Yetman (2005), "Natural Disaster Hotspots: A Global Risk Analysis," The World Bank.

Section 1.03 European Parliament and Council (1996), Directive of 11 March 1996 on the Legal Protection of Databases, 1996 O.J. (L77) 20, available at: **http://europa.eu.int/comm/internal_market/en/intprop/docs/**.

Gabrynowicz, Joanne Irene (2002), "A Case of First Impression: the US Government-SpaceImaging Contract for Afghan Imagery," IAF abstracts, 34th COSPAR Scientific Assembly, The Second World Space Congress, held 10-19 October, 2002 in Houston, TX, USA., p.IISL-3-23IAF abstracts, 34th COSPAR Scientific Assembly.

Gerhard, Michael and Bernhard Schmidt-Tedd (2005), "Regulatory Framework for the Distribution of Remote Sensing Satellite Data: Germany's Draft Legislation on Safeguarding Security Interests," 48th Colloquium on the Law of Outer Space 2.

Global Earth Observing System of Systems (2005) "GEOSS 10-Year Implementation Plan" (as adopted 16 February 2005), available at: **http://www.Earthobservations.org/docs/10-Year%20Implementation%20Plan.pdf**.

Intergovernmental Panel on Climate Change (2007a), *Climate Change 2007 - The Physical Science Basis*, Cambridge University Press, available at: **http://www.ipcc.ch/ipccreports/ar4-wg1.htm**.

Intergovernmental Panel on Climate Change (2007b), *Climate Change 2007 - Impacts, Adaptation and Vulnerability*, Cambridge University Press, available at: **http://www.ipcc.ch/ipccreports/ar4-wg2.htm**.

Intergovernmental Panel on Climate Change (2007c), Cambridge University Press, available at: **http://www.ipcc.ch/ipccreports/ar4-wg3.htm**.

International Charter (2000), "Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters," available at: **http://www.disasterscharter.org/charter_e.html**.

International Oceanographic Commission (2002), "IOC Oceanographic Data Exchange Policy, UNESCO, available at: **http://www.iode.org/index.php?option=com_content&task=view&id=51&Itemid=95**.

Kaul, Inge, Isabelle Grunberg, and Mark A. Stern (1999), "Defining Global Public Goods," in *Global Public Goods: International Cooperation in the 21st Century*, Kaul, Grunberg, and Stern, eds., Oxford University Press, summary available at: **http://www.undp.org/globalpublicgoods/Executive_Summary/executive_summary.html**.

Longworth, Elizabeth (2000), "The Role of Public Authorities in Access to Information: The Broader and More Efficient Provision of Public Content" UNESCO, 55 p., available at: **http://webworld.unesco.org/infoethics2000/documents/study_longworth.rtf**.

Mann, Bruce (2006), "Drafting Legislation to Regulate Commercial Remote Sensing Satellites: A How-To Guide from Canada," 49th Colloquium on the Law of Outer Space 3.

Mayo, Ed and Tom Steinberg (2007), "The Power of Information," 57 p., available at: **http://www.cabinetoffice.gov.uk/upload/assets/www.cabinetoffice.gov.uk/strategy/power_information.pdf**.

National Research Council (NRC) (1997), *Bits of Power: Issues in Global Access to Scientific Data*, National Academy Press, 250 p., available at: **http://books.nap.edu/catalog/5504.html**.

NRC (1999), *A Question of Balance: Private Rights and the Public Interest in Scientific and Technical Databases*, National Academy Press, 142 p., available at: **http://books.nap.edu/catalog/9692.html**.

NRC (2002), *Down to Earth: Geographic Information for Sustainable Development in Africa*," National Academy Press, 155 p., available at: **http://www.nap.edu/catalog/10455.html**.

NRC (2003), Julie M. Esanu and Paul F. Uhlir, eds., *The Role of Scientific and Technical Data and Information in the Public Domain: Proceedings of a Symposium*, National Academies Press, 238 p., available at: **http://books.nap.edu/catalog/10785.html**.

NRC (2004), Julie M. Esanu and Paul F. Uhlir, eds., *Open Access and the Public Domain in Digital Data and Information for Science: Proceedings of an International Symposium*, National Academies Press, available at: **http://www.nap.edu/catalog.php?record_id=11030**.

Organisation for Economic Co-operation and Development (OECD) (1980), "The OECD Guidelines on the Protection and Transborder Flows of Personal Data," 64 p., available at: **http://oecdpublications.gfi-nb.com/cgi-bin/OECDBookShop.storefront/EN/product/932002011E1/**.

OECD (2006), "DIGITAL BROADBAND CONTENT: PUBLIC SECTOR INFORMATION AND CONTENT," Working Party on the Information Economy. DSTI/ICCP, 82 p., available at: **http://www.oecd.org/dataoecd/10/22/36481524.pdf**.

OECD (2007), Principles and Guidelines for Access to Research Data from Public Funding," 22 p., available at: **http://www.oecd.org/dataoecd/9/61/38500813.pdf.**

Office of Management and Budget (1996), Circular A-130, "Management of Federal Information Resources," U.S. Government Printing Office, Washington, D.C., available at: **http://www.whitehouse.gov/omb/circulars/a130/a130trans4.html**.

Office of Science and Technology Policy (1991), "Policy Statements on Data Management for Global Change Research," DOE/EP-0001P, Washington, DC, available at: **http://www.gcrio.org/ocp97/box1ch3.html**.

PIRA International (2000), *Commercial Exploitation of Europe's Public Sector Information*, Report for the European Commission, Directorate General for the Information Society. Executive summary available at: **http://www.ekt.gr/cordis/news/eu/2001/01-01-19econtent/econtent_study2.pdf**.

Reichman, J.H. and Paul F. Uhlir (Winter/Spring 2003), "A Contractually Reconstructed Research Commons for Scientific Data in a Highly Protectionist Intellectual Property Environment," 66 Law and Contemporary Problems, p. 315-462, available at: **http://www.law.duke.edu/journals/lcp/downloads/LCP66DWinterSpring2003P315.pdf**.

Stiglitz, Joseph, Peter Orszag, and Johathan Orszag (2000), *The Role of Government in a Digital Age*, Computer and Communications Industry Association, Washington, DC., available at: **http://www.ccianet.org/docs/filings/govtcomp/govtcomp_report.pdf**.

Uhlir, Paul F. and Peter Schröder (2007), "Open Data for Global Science," CODATA Data Science Journal, available at: **http://dsj.codataweb.org/special-open-data.html**.

Uhlir, Paul F. (2004), "Policy Guidelines on the Development and Promotion of Governmental Public Domain Information," UNESCO, available at: **http://www.fas.org/sgp/library/unesco_govinfo.pdf**.

United Nations (1967), "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies," (document A/6431), available at: **http://www.unoosa.org/oosa/en/SpaceLaw/gares/html/gares_21_2222.html**.

United Nations (2002), "Johannesburg Declaration on Sustainable Development," UN Department of Economic and Social Affairs, World Summit on Sustainable Development, available at: **http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/POI_PD.htm**.

United Nations Development Program (2004), *Reducing Disaster Risk: A Challenge for Development.* New York: UNDP.

Available at: **http://www.undp.org/cpr/whats_new/rdr_english.pdf**.

United Nations Educational, Scientific, and Cultural Organisation (UNESCO) (2004), "Collection of National Copyright Laws," available at: **http://portal.unesco.org/culture/en/ev.php@URL_ID=14076&URL_DO=DO_TOPIC&URL_SECTION=201.html**.

UNESCO (21 November 2003), Recommendation on the Promotion and Use of Multilingualism and Universal Access to Cyberspace and Report by the Director-General (31 C/25), available at: **http://portal.unesco.org/ci/ev.php?URL_ID=13475&URL_DO=DO_TOPIC&URL_SECTION=201&reload=1082057417**.

United Nations General Assembly (3 December 1986), "Principles relating to the remote sensing of the earth from space," (A/RES/41/65), available at: **http://www.un.org/documents/ga/res/41/a41r065.htm**.

UNGA (2000), *United Nations Millennium Declaration*, A/RES/55/2 8 Sept. 2000, available at: **http://www.un.org/millennium/declaration/ares552e.htm**.

Weiss, Peter (2003), "Conflicting International Public Sector Information Policies and Their Effects on the Public Domain and the Economy," in NRC (2003), available at: **http://books.nap.edu/openbook.php?record_id=10785&page=129**.

World Intellectual Property Organization – WIPO (1996), Copyright Treaty, adopted in Geneva on 20 December 1996, available at: **http://www.wipo.int/treaties/en/ip/wct/index.html**.

WIPO (1979), Berne Convention for the protection of Literary and Artistic Works, Paris Act of 24 July 1971, as amended on 28 September 1979, available at: **http://www.wipo.int/treaties/en/ip/berne/index.html**.

World Summit on the Information Society – WSIS (2003), "Declaration of Principles – Building the Information Society: a global challenge in the new Millennium," WSIS-03/GENEVA/DOC/4-E, 12 December 2003, available at: **http://www.itu.int/wsis/documents/index.html.**

APPENDIX C

Regional European Data Sharing Policies

European Community – directive on re-use of public sector information	Members: European Union (27 Member States) + EEA Countries (Iceland, Norway and Liechtenstein)	Directive 2003/98 of the European Parliament and of the Council of 17 November 2003 on the re-use of public sector information (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:345:0090:0096:EN:PDF	The PSI directive lays down a minimum set of rules for public sector bodies to make their documents available to the private sector for re-use. Re-use is defined as "the use by persons or legal entities of documents held by public sector bodies, for commercial or non-commercial purposes other than the initial purpose within the public task for which the documents were produced. Exchange of documents between public sector bodies purely in pursuit of their public tasks does not constitute re-use." Member states are not under any obligation to make their documents available for re-use, but are encouraged to do so under specified conditions. These conditions include time limits, available formats, fees and transparency. The directive also makes sure the public sector bodies comply with the rules of fair competition. If a public sector body creates value-added products or services on the basis of its own documents for commercial activities outside of the scope of its public tasks, the same charges and conditions should apply to the supply of the documents as those for other users. Exclusive agreements are prohibited, unless such an exclusive right is necessary for the provision of a service in the public interest.

European Community – directive on public access to environmental information	European Union (27 Member States) and EEA (Liechtenstein, Norway and Iceland)	Directive 2003/4 of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EC (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:041:0026:0032:EN:PDF)	The directive on access to environmental information aims to guarantee the right of access to environmental information held by or for public authorities and to ensure that environmental information is progressively made available to the public. It introduces the dispositions of the Aarhus Convention in Community law. The directive ensures free-of-charge on-site viewing of environmental information while allowing the public authorities to charge a reasonable fee for supplying the information. As a general rule, the charges may not exceed the costs of production. However, when a public authority makes its environmental information available commercially in order to guarantee continued collection and publication of such information, market rate charges are allowed. The directive also contains obligations for the Member States regarding the dissemination of environmental information. The Member States have to ensure that environmental information progressively becomes available in electronic databases which are easily accessible to the public through telecommunication networks. The Member States have to take the necessary measures to ensure that, in the event of an imminent threat to human health or the environment, whether caused by human activities or due to natural causes, all information held by or for public authorities which could enable the public likely to be affected to take measures to prevent or mitigate harm arising from the threat is disseminated, immediately and without delay.

Europe – EUMETSAT www.eumetsat.int	Members: Austria, Belgium, Croatia, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom Cooperating States: Czech Republic, Poland, Slovenia, Hungary, Romania, Latvia, Lithuania, Bulgaria, Iceland, Estonia	Convention for the establishment of a European Organisation for the exploitation of meteorological satellites as amended by the EUMETSAT Council in Resolution EUM/C/Res. XXXVI of 5 June 1991, and subsequently accepted by all EUMETSAT Member States EUMETSAT Data Policy document (Council Resolution EUM/C/98/ Res.IV)	**Availability of data for the Member States** The National Meteorological Services (NMSs) of the Member States receive all EUMETSAT data, products and services for their official duty at no cost, except for the cost of decryption key units. Official Duty is defined as all activities which take place within the organisation of a NMS and external activities of a NMS resulting from legal, governmental or intergovernmental requirements relating to defence, civil aviation and the safety of life and property. Insofar as required for Official Duty use, the NMSs may grant access to other Departments within their respective National Administrations, subject to arrangements in accordance with national legislation, but all conditions defined in the data policy remain attached to the use of the data. **Availability of data for others** • Essential data The EUMETSAT Council has defined a set of data, products and services that is available on a free and unrestricted basis as "essential" data and products in accordance with WMO Resolution 40 (Cg-XII). • Non-essential data NMSs of non-Member States have access without charge to Three-hourly Meteosat Data for Official Duty use. They have access to Hourly, Half-hourly and Quarter-hourly Meteosat Data for Official Duty use in accordance with the conditions specified in the data policy. The annual fees are determined

			based on the GNI per capita derived from World Bank Statistics. For limited periods, to support the monitoring of disasters or emergencies and in accordance with relevant UN resolutions, the full set of Meteosat Data will be made available without charge. For Official Duty use by NMSs of non-Member States subject to tropical cyclones, the full set of Meteosat Data will be made available without charge.
European Space Agency www.esa.int – ENVISAT, Earth Explorer	Members: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. Canada, Hungary and the Czech Republic also participate in some projects under cooperation agreements.	Convention for the establishment of a European Space Agency of 30 May 1975 ENVISAT Data Policy of 19 February 1998	The conditions attached to the distribution of Envisat or Earth Explorer data depend on the use of the data. The following two categories of use are defined. *Category 1 use*. Research and *applications development* use in support of the mission objectives, including research on long term issues of Earth system science, research and development in *preparation for future operational use*, certification of receiving stations as part of the ESA functions, and ESA internal use. *Category 2 use*. All other uses which do not fall into category 1 use, including operational and commercial use. Envisat data is available in an *open and non discriminatory way*, in accordance with the United Nations Principles on Remote Sensing of the Earth from Space (United Nations Resolution 41/65, 3 December 1986). The Envisat distributing entities have to provide services to users in a fair and non-discriminatory way.

			ESA determines the price for all Envisat data intended for category 1 use. The price is set at or near the cost of reproduction of the data. Envisat products for category 1 use are disseminated under controlled licensing conditions which stipulate the rights of use and further distribution. If the data are received free, the rights of use will include the obligation to report on and publish the research findings from the use of Envisat data, and the obligation to present such results in symposia organised by ESA. ESA has delegated the responsibility for disseminating data and products for category 2 use to a number of distributing entities. These entities are selected through a tender procedure. For category 2 use, ESA determines the price of Envisat standard products and services which it provides to the distributing entities. The price is set at a level comparable to the price for category 1 use. Distributing entities are allowed to set prices for Envisat standard products and services at or above the price level which ESA charges the distributing entities. For specific purposes, and with the prior agreement of ESA, distributing entities will be allowed to set prices for data products below the price level which ESA charges the distributing entities.
EUROPE – GMES www.gmes.info	Cooperation between European Union (27 Member States) and European Space Agency	Council Resolutation of 16 November 2000 on a European space strategy “A European Approach to Global Monitoring For Environment and Security	No official data policy available yet. One of the tasks of the GMES Bureau is to develop a data policy for the different types of data that are involved in GMES. To prepare this policy, a study was made by University College London for the Working Group on Data Policy Assessment. The

		(GMES): Towards Meeting Users' Needs", joint document from ESA and the European Commission Communication from the European Commission to the Council and the European Parliament of 10 November 2005, "Global Monitoring for Environment and Security (GMES): From Concept to Reality" Commission Decision of 8 March 2006 creating a Bureau for Global Monitoring for Environment and Security (GMES)	document can be found at http://www.gmes.info/library/ index.php?action=standarddownload&filename= DPAGDFinalReport.pdf&directory=6.%20Cross-Cutting%20Studies%20Documents&
European Union INSPIRE – www.ec-gis.org/inspire	European Union (27Member States)	Directive 2007/2 of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)	The aim of INSPIRE is to create an infrastructure for spatial information in the European Community for the purposes of European Community environmental policies or activities which may have an impact on the environment. The European Directive has entered into force on 15 May 2007 and has to be transposed into national legislation by 15 May 2009. INSPIRE is based on the following data principles: • Data should be collected once and maintained at the level where this can be done most effectively. • It should be possible to combine seamlessly spatial data from different sources and share it between

			many users and applications. • Spatial data should be collected at one level of government and shared between all levels. • Spatial data needed for good governance should be available on conditions that do not restrict its extensive use. • It should be easy to discover which spatial data is available, to evaluate its fitness for purpose and to know which conditions apply for its use. It applies to 34 spatial data themes, including coordinate reference systems, administrative units, hydrography, land cover, orthoimagery, geology, meteorological geographic features, … The INSPIRE directive contains obligations for the Member States and their public authorities regarding the creation of metadata and data specifications. The Member States also have the obligation of providing a network of services for the spatial data themes in the annexes: - discovery services making it possible to search for spatial data sets and services on the basis of and to display the content of the metadata; - view services making it possible, as a minimum, to display, navigate, zoom in/out, pan, or overlay viewable spatial data sets and to display legend information and any relevant content of metadata; - download services, enabling copies of spatial data sets, or parts of such sets, to be downloaded and, where practicable, accessed directly; - transformation services, enabling spatial data sets to be transformed with a view to achieving interoperability; - services allowing spatial data services to be 'invoked'.

			Access to these services must be provided through the geo-portal that will be established by the European Commission. Discovery and view services have to be provided free of charge. However, it is possible for a public authority to charge for the use of the view service, where such charges secure the maintenance of spatial data sets and corresponding data services, especially in cases involving very large volumes of frequently updated data. The other services can be charged for by choice of the Member States. The directive also contains obligations concerning data-sharing between the public authorities. The Member States have to adopt measures for the sharing of spatial data sets and services between their public authorities, enabling these public authorities to gain access to spatial data sets and services, and to exchange and use those sets and services, for the purposes of public tasks that may have an impact on the environment. These measures have to preclude any restrictions likely to create practical obstacles, occurring at the point of use, to the sharing of spatial data sets and services. It is allowed for public authorities to licence spatial data sets and services and/or require payment from other public authorities or the institutions and bodies of the European Community. These charges and licenses have to be compatible with the general aim of facilitating the sharing of spatial data sets and services. Where charges are made, these have to be kept to the minimum required to ensure the necessary quality and supply of spatial data sets and services together with a reasonable return on investment, while respecting the self-financing

			requirements of public authorities supplying spatial data sets and services, where applicable. Spatial data that is provided by the Member States to the institutions and bodies of the European Community in order to fulfil their reporting obligations under the environmental Directives are not subject to any charging. The data sharing arrangements that are set up by the Member States under these rules have to be open, on reciprocal and equivalent basis, to bodies established by international agreements to which the European Community and Member States are parties. Member States can limit sharing when it would compromise the course of justice, public security, national defence or international relations. Specific Implementing Rules will be created addressing the dissemination of spatial data by the Member States to the bodies and institutions of the European Community.
Europe – EIONET www.eionet.europa.eu	Members: European Union (27 Member States), 4 EFTA Countries (Iceland, Norway, Liechtenstein and Switzerland), Turkey and European Environment Agency. FYR Macedonia, Croatia, Bosnia &	Council Regulation (EEC) on the establishment of the European Environment Agency and the European environment information and observation network (Eionet) [No.1210/90	Eionet is a partnership network of the European Environment Agency (EEA) and its member and participating countries. It consists of the EEA itself, a number of European Topic Centres (ETCs) and a network of around 900 experts from 37 countries in over 300 national environment agencies and other bodies dealing with environmental information. These are the national focal points (NFPs) and the national reference centres (NRCs). Eionet aims to provide timely and quality-assured

	Herzegovina, Serbia, Montenegro and Albania also participate in the EEA and Eionet work.		data, information and expertise for assessing the state of the environment in Europe and the pressures acting upon it. This enables policy makers to decide on appropriate measures for protecting the environment at national and European level and to monitor the effectiveness of policies and measures implemented. The European Environmental Agency has identified a set of priority annual data flows, in the area of air quality, air emissions, inland waters, marine and coastal waters, contaminated soil, nature conservation and land cover. These data are used to update the core set of environmental indicators which form the basis of EEA reports and assessments. As far as possible, data and information which have already been reported by the countries in the framework of EU or international obligations are used within Eionet, entailing that data collected once at a national level can be used for many purposes at national, EU and international level. The data service provides access to most data sets and applications which have been used in EEA's periodical environmental reports and metadata for data that are maintained by other international organisations. In the Data section data sets can be accessed. The data sets contain aggregated data, typically on a country level, with a geographical coverage of at least 15 EU Member States. Graphs and, in the future, maps can be generated from the datasets. Information about the source of each data set and its geographical and temporal coverage is provided. In the Maps and graphs section one can find and

			download maps and graphs used in EEA products.
European Community – Water Framework Directive & WISE (water information system for Europe)	27 Member States + Norway Cooperation with European Commission, European Environment Agency for WISE portal	Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for the Community action in the field of water policy	The Water Framework Directive is a legislative framework to protect and improve the quality of all water resources such as rivers, lakes, groundwater, transitional and coastal water within the European Union. One of the key activities under the joint implementation for the Water Framework Directive is the improvement of the information exchange between Countries, European institutions, the various stakeholders and the interested public. In order to promote an increases information exchange and to facilitate the work in the numerous expert groups, the Commission set up an internet-based platform, the so-called "WFD CIRCA" (see http://ec.europa.eu/environment/water/water-framework/iep/index_en.htm) WISE (the Water Information System for Europe) is being developed since 2006 and should be fully operational by 2010. It will serve as the electronic reporting system for the Member States for reporting on the monitoring frameworks of the Water Framework Directive and for reporting under the Urban Waste Water Treatment Directive (UWWD)[1], Bathing Water Directive (BWD), Nitrate Directive (NiD), Drinking Water Directive (DWD) and other mandatory or voluntary reporting to the EU level, in particular submissions to the European Environment Agency (EEA) and ESTAT. All authorised WISE data providers which have the right to upload data into WISE, which are officially

1 For example, the reporting for Urban Waste Water Treatment Directive on the basis of Articles 15(4), 16, 17 is foreseen via WISE in 2009 at the latest.

			nominated for compliance reporting or submitting other data will be able to view all the submitted data. After the data submission has been finalised, the correspondent folder will be released by the authorised WISE data providers of the Member State. This means that viewing and download of datasets will be possible for all other authorised WISE data providers unless the data provider has explicitly restricted the data dissemination (see http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/w-wise_background&vm=detailed&sb=Title) . The WISE data policy (for spatial and non-spatial data) defines the arrangements for use and publication of the information and data submitted to WISE. As a matter of principle, all information and data will mostly be used within the EU bodies mainly for the purpose that they have been defined for in the approved reporting sheets. However, such data can also be used for other uses inside the European Commission and the EEA on the basis that such use is appropriate and that the original information and data is not made publicly available (internal use only). The intention is to minimise the restrictions on publication and in any case to make WISE data available free-of-charge in accordance with INSPIRE, with specific conditions for external use.
European Community - SEIS (Shared Environmental Information System)	EC (27 Member States)	Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions	The Communication sets out a set of principles on the basis of which the collection, exchange and use of environmental data and information should be organized in the future. In the course of 2008, a legislative instrument will be proposed to formalize these principles.

		– Towards a Shared Environmental Information System (COM(2008) 46 final, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0046:FIN:EN:DOC)	The principles upon which the Shared Environmental Information System (SEIS) is to be based are as follows: • information should be managed as close as possible to its source; • information should be collected once, and shared with others for many purposes; • information should be readily available to public authorities and enable them to easily fulfil their legal reporting obligations; • information should be readily accessible to end-users, primarily public authorities at all levels from local to European, to enable them to assess in a timely fashion the state of the environment and the effectiveness of their policies, and to design new policy; • information should also be accessible to enable end-users, both public authorities and citizens, to make comparisons at the appropriate geographical scale (e.g. countries, cities, catchment areas) and to participate meaningfully in the development and implementation of environmental policy; • information should be fully available to the general public, after due consideration of the appropriate level of aggregation and subject to appropriate confidentiality constraints, and at national level in the relevant national language(s); and • information sharing and processing should be supported through common, free open-source software tools. An implementation plan will be drawn up by the Commission in 2008, in collaboration with Member States and the European Environmental Agency.
ECOMET	National Meteorological Services of 23 states	Economic Interest Grouping under Belgian Law, established in 1995	ECOMET was established by its members to ensure the availability of meteorological data to the public sector within the framework of WMO

	(Austria, Belgium, Croatia, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Luxembourg, Netherlands, Norway, Portugal, Romania, Spain, Sweden, Switzerland, Turkey, United Kingdom Slovenia is a prospective member		Resolution 40, and to organize the dealings with the private sector in a manner that complied with European competition law. The European Commission recognized ECOMET as a cartel under competition law, but allowed it under th exemption clause in 1999. However, this exemption has recently expired and a new exemption has not been given yet. Ecomet's further objectives are to guarantee access to meteorological data and products, while recovering part of the infrastructural expenses of the NMSs by contributions from the commercial users. All data that is available in the ECOMET catalogue. The catalogue contains different categories of data: - non-chargeable data and product set: all data and products that are classified as "essential" in WMO resolution 40; - other data and product sets, that are commercially available against a licence fee; - -data and products from non-ECOMET members Licensing conditions differ for different types of use: - publishers and broadcasters; - service providers; - redistribution of real time data and products as part of a value added service - internet broadcasting - redistribution of data and products from holding company to subsidiary company - research Prices for the data can be found on the ECOMET website. The actual price contains three elements:

			- information price as stated on the website - delivery price, determined by the delivering NMS - transmission price, which is the cost of the means of delivery The ECOMET General Assembly has established some tariff modulations for specific situations or data. For more information, see www.ecomet.eu.

Table compiled by Katleen Janssen

APPENDIX D

National Remote Sensing Laws and Policies

Country	National Space and/or Remote Sensing Law	Relevant Regulations, Policies, and Some Other Related Laws	Data Policy
Argentina	Creation of the National Commission on Space Activities, National Decree No. 955/91 Establishment of the National registry of Objects Launched into Outer Space, National Decree,125/95	None	National Commission of Space Activities data distribution policy allows for free and open access of data, catalyzed by the nation's interest in prevention and preparedness for future disasters. Can engage in commercial activities and distribute data accordingly.
Australia	Space Activities Act of 1998, No. 123	Space Activities Regulations of 2001, No. 186, *Regulatory Practices for National Space Organizations*, Procedure for licensing, operating and launch activities	GeoScience Australia provides data free on the internet and sells it in a packaged form on CD.
Austria	None	None	None

Belgium	Law on the Activities of Launching, Flight Operations or Guidance of Space Objects	In progress	In progress
Brazil	Law No. 8.854 of 10 February 1984 (Established the Brazilian Space Agency) Resolution on Commercial Launching Activities from Brazilian Territories, Resolution No. 51, Jan. 26, 2001 Resolution on procedures and on definition of necessary requirements for the request, evaluation, issuance, follow-up and supervision of licenses for carrying out launching space activities on Brazilian territory, Administrative Edict No. 27, June 20, 2001 Complementary Protocol to the Framework Agreement Between the Government of the People's Republic of China and the Government of the Federative Republic of Brazil on Cooperation in the Peaceful Applications of Outer Space Science and Technology on the Cooperation for the CBERS Application System, 2004. For the Government of the Federative Republic of Brazil For the Government of the People's Republic of China CBERS Data Policy	Portaria AEB (Administrative Edict), No. 27, Regulation on procedures and on definition of necessary requirements for the request, evaluation, issuance, follow-up and supervision of licenses for carrying out launching space activities on Brazilian Territory.	Summary: Currently under CBERS agreement, open access but possible movement to adopt other policies. Data downlinks licensed based on per-minute fee basis. China and Brazil may agree in a few special cases agree to transfer data free. Now includes Mozambique, Angola, and some other African countries. CRESDA and Brazilian ground stations have unlimited access. Distributors are licensed. Independent price list for distribution solely within national market. Can not be exported abroad. INPE and CRESDA set international prices. General Considerations: The downlink data is open to any country or organization and is based on the conception that CBERS imagery will be distributed by licensed representatives who operates an application system infrastructure that performs data reception and processing. . . .Each ground station receives the image raw data and process it into image products, which will then be distributed to users. The licensing of CBERS data downlinks is based on fees which are charged in a per-minute basis. China and Brazil may, in a few special cases, upon mutual consultation, decide on the transfer of data free of charge. The ground stations operated by INPE in Brazil and by

			CRESDA in China have unlimited access to all data collected within their footprint. The policy for distribution of data collected by those ground stations will be defined by each operator. Licensing Policy For International Ground Stations (a) CBERS data reception, processing and distribution to other countries will be carried out by licensed representatives jointly appointed by CRESDA and INPE. (b) The licensed representative will commercialize CBERS data downlink to ground stations based on a annual fixed basis, based on a fee determined by INPE and CRESDA. The annual fee will be determined by the conditions of the ground stations, including geographical location and antenna footprint. Product Distribution Policy The commercial agreement between licensed representatives and distributors shall include the following: (a) The right of receiving, processing and distributing CBERS data shall be granted to the distributor by the licensed representative…… (f) Each distributor could set its native price list independently for distribution solely within its respective national market. Images distributed within the distributor's national market may not be exported abroad. (g) When distributing abroad, the distributor must refer to the international

			price list set by INPE and CRESDA.
Canada	Canadian Space Agency Act, 1990, c. 13 (Assented to May 10, 1990). Remote Sensing Space Systems Act, 2005	Bilateral US-Canada Agreement on Commercial Remote Sensing Satellite Systems Department of Industry Act Department of Foreign Affairs and International Trade Act National Defence Act Canadian Charter of Rights and Freedoms, Article 1 Personal Information and Electroniocs Documents Act Access to Information Act	Incorporates all aspects of Canadian Access Control policy. Availability in accord with UN Remote Sensing Principles. Sensed states only automatically given access to data for improving natural resources management. License Conditions: Raw data and remote sensing products from the system about the territory of any country—but not including data or products that have been enhanced or to which some value has been added—be made available to the government of that country within a reasonable time, on reasonable terms and for so long as the data or products have not been disposed of" Priority access: Minister of Foreign Affairs may order if there are reasonable grounds that continued operations would be injurious to international relations inconsistent with international obligations Minister of Defence may order if there are reasonable grounds that continued operation would be injurious to defence of Canada or safety of Canadian Forces Solicitor General may order any service to Royal Canadian Mounted Police Canadian Security Intelligence

			Government for critical infrastructure protection or emergency preparedness Reasonable grounds service is desirable to fulfill respective responsibilities
China	Provisions and Procedures for the Registration of Space Objects, 2001. Interim Measures on the Administration of Permits for Civil Space Launch Projects, 2002. Complementary Protocol to the Framework Agreement Between the Government of the People's Republic of China and the Government of the Federative Republic of Brazil on Cooperation in the Peaceful Applications of Outer Space Science and Technology on the Cooperation for the CBERS Application System, 2004. For the Government of the Federative Republic of Brazil For the Government of the People's Republic of China CBERS Data Policy	None known. General policy statement in a white paper: China's Space Activities by The State Council Information Office, P.R.C. November, 2000; Beijing CNSA 2003-12-15. "The Chinese government holds that international space cooperation should follow the fundamental principles listed in the "Deceleration [sic] on International Cooperation on Exploring and Utilizing Outer Space for the Benefits and Interests of All Countries, Especially in Consideration of Developing Countries' Demands" General policy statement in an October 12, 2006 white paper from the Information Office of China's State Council titled "China's Space Activities in 2006".: "China is unflinching in taking the road of peaceful development, and always maintains that outer space is the common wealth of mankind. While supporting all activities that utilize outer space for peaceful purposes, China actively explores and uses outer space and continuously makes new contributions to the development of man's space programs."	Summary: Currently under CBERS agreement, open access but possible movement to adopt other policies. Data downlinks licensed based on per-minute fee basis. China and Brazil may agree in a few special cases agree to transfer data free. Now includes Mozambique, Angola, and some other African countries. CRESDA and Brazilian ground stations have unlimited access. Distributors are licensed. Independent price list for distribution solely within national market. Can not be exported abroad. INPE and CRESDA set international prices. General Considerations: The downlink data is open to any country or organization and is based on the conception that CBERS imagery will be distributed by licensed representatives who operates an application system infrastructure that performs data reception and processing. . . .Each ground station receives the image raw data and process it into image products, which will then be distributed to users. The licensing of CBERS data downlinks is based on fees which are charged in a per-minute basis. China and Brazil may, in a few special cases, upon mutual consultation, decide on the transfer of data free of charge. The ground stations

			operated by INPE in Brazil and by CRESDA in China have unlimited access to all data collected within their footprint. The policy for distribution of data collected by those ground stations will be defined by each operator. Licensing Policy For International Ground Stations (a) CBERS data reception, processing and distribution to other countries will be carried out by licensed representatives jointly appointed by CRESDA and INPE. (b) The licensed representative will commercialize CBERS data downlink to ground stations based on a annual fixed basis, based on a fee determined by INPE and CRESDA. The annual fee will be determined by the conditions of the ground stations, including geographical location and antenna footprint. Product Distribution Policy The commercial agreement between licensed representatives and distributors shall include the following: (a) The right of receiving, processing and distributing CBERS data shall be granted to the distributor by the licensed representative…… (f) Each distributor could set its native price list independently for distribution solely within its respective national market. Images distributed within the distributor's national market may not be exported abroad. (g) When distributing abroad, the

			distributor must refer to the international price list set by INPE and CRESDA.
European Community		EC Directive 96/9/EC, Articles 7 (1); 10 (1); 10 (2); 10 (3); Recital 41; Recital 53	
France	Draft Law for General Space Activities accompanied by Advisory Letter from the Conseil d'Etat, French High Court on Administrative Matters. It is likely to have a separate chapter to include remote sensing rules. Government of France – CNES Administrative Act Loi N° 61-1382, dated 19/12/1961JO 10/12	Decree n° 84-510, dated 28 June 1984, named, Décret relatif au Centre national d'études spatiales (JO 29/06), modified by decree n° 89-77 (6/2/1989), decree n° 93-277 (03/03/1993, decree n° 93-1441 (27/12/1993) and decree n° 96-308 (10/04/1996). Additional, In progress.	EC Database Protection Directive 96/9/CE (1996) implemented by Loi 98-536. Additional, in progress.
Germany	Satellitendatensicherhertsgesetz Proposed 3-part law, drafted and in progress.	Proposed. For advanced systems. Three kinds of licenses: 1. satellite operation 2. general data distribution 3. specific data transactions	Proposed. National security is priority with commercial aspects secondary. Intent of proposed data distribution mechanism is to create a system in which an operator ("Betreiber"), a distributor ("Datenanbieter") or an operator/distributor ("Betreiber zugleich Datanbieter") will be licensed. To distribute data to users, they will be required too implement a "geomatrix" provided by the government that includes a check list to determine sensitivity of the transaction. There is potential liability if a distribution mistake is made. Penalties may include incarceration.
Hong Kong	An Ordinance to Confer	None.	None.

(special administrative region of China)	Licensing and Other Powers on the Chief Executive to Secure Compliance with International Obligations of the People's Republic of China with Respect to the Launching and Operation of Space Objects and the Carrying on of Other Activities in Outer Space, 13 June 1997, amended 1999.		
India	No space or remote sensing law.	No space or remote sensing regulations. Information Act 2000 Convergence Act 2001 Indian Constitution, Art. 51	Remote Sensing Data Policy (RSDP), ISRO: EOS:Policy-01:2001 Indian Space Research Organisation HQ, Bangalore-560 094 Government owns all data. All data up to 5.8 m is available. Higher on a case-by-case basis. High-resolution committee established. Restricts access to some foreign data within India.
Iran	Parliament approved bill to establish Iranian Space Agency, 2003 Decisions of the Supreme Aerospace Council	None	None
Japan	Law Concerning Japan Aerospace Exploration Agency. Law No. 161 of 13th December 2002, Chapter 3: Operations, Article 18: (Scope of Activities), 1. (5) "Dissemination of the activities referred to in each of the preceding Items, and promotion of utilization thereof." Japanese Draft Basic Law on Space Development (in progress).	Fundamental Policy of Japan's Space Activities, Revised on January 24, 1996, Space Activities Commission The Basic Law on Science and Technology (1995) 1999 Law Concerning Access to Information Held by Administrative organs, Law No. 42.	1. Long Term Plan of Space Development. Issued by Space Activities Commission (SAC) in September 2003' "Japan shall develop data archive systems so that users can use satellite observation data easily and effectively and promote utilization and circulation of data." 2. Japan's Earth Observation Satellite Development Plan and Data Utilization Strategy. Issued by Space Activities

			Commission (SAC) in July 2005. 3. Earth Observation Promotion Strategy, Council for S&T Policy, Cabinet Office, Govt. of Japan, 27 December 2004 Detailed data policy for each satellite in progress. No formalized policy. Currently thinking about this. In principle: all data open to public. No specific resolution limit.. Satellite by satellite basis. Who is requesting data and why? Could be discussed internally. Guiding principles: --All data can only be used for peaceful purposes. --JAXA retains intellectual property rights to all data User categories: 1. Public data users Contribute to promotion of data utilization Cost of reproduction Should be “almost no charge” on networks Distributed by JAXA 2. Other data users Includes commercial Low price but not less than offered by private companies Distributed through private enterprise National security Information Gathering Satellite (IGS) Classified data

			Rules to be established for processed data Solve Earth observation data provision issues Encourage data use Ideal Ways to Provide data: --Government initiative and must be made widely available to benefit society --implement standard data processing and enable people other than observation technology experts to use data --establish environment to have private entities meet various needs --use the Internet
Malaysia	Security Act	Instruction 20 for Disaster Response National Space Policy	No restrictions on data distribution until higher than 5 meters spatial resolution. Then inquiry is made into who is buying the data and why. Similar policy regarding topographic maps. A restricted data policy is in review for space and aerial data for both foreign and Razaksat data. Malaysian Federal Treasury Department sets data pricing policy. Need to sell data at twice the cost to recover costs. Client's Charter. Provides data and value added products on commercial contract basis. Time line: Digital 5 days Computer printed product 2 – 3 weeks Photographic printed product 2 – 3 weeks

			Digital or printed value-added product 4 – 6 weeks Data and information for disaster applications "utmost priority" and as soon as technically possible.
Nigeria	None	Prohibitions of Copyright Act National Geospatial Data Infrastructure Policy Legal Subcommittee	In process by National Geospatial Data Infrastructure Policy Legal Subcommittee (to include data derived from *Nigeriasat* 2)
Poland	None	None	As per contract with satellite data provider and, by incorporation, national requirements to which the satellite data provider is subject.
Russian Federation	Law on Space Activities, Federal Law No. 5663-1, from August 20, 1993, as amended by Federal law No. 147-F3, 1996.	Rules on the Licensing of Space Activities, Rules No. 403 from June 30, 2006.	1996 National Space Policy Concept Unpublished National Remote Sensing Development Concept in progress.

South Africa	South African Space Affairs Act, No. 64, 1995. (Expected to be substantially revised soon.)	None	None specifically related to data from national satellites. Emerging data policy has not yet been published, but the intention is to grant free access to academic and government users. The question of whether commercial users should pay costs has not been resolved yet. Other data generated by publicly funded institutions makes data as widely and as easily accessible as possible, and commercial users are charged.
South Korea	Law on Space Activities, Federal Law No. 5663-1, from August 20, 1993, as amended. Act on the Promotion of Space Activities, Nov 2005	None	None
Spain	Royal Decree No.278-1995, Space Exploration.	None	None

Thailand	None	None	Lower price to government than private sector. Free data for educational use, use report required in exchange. Data access is on a case-by-case basis for the private sector. Free data for disasters. Policy being formulated for THEOS. Should be nondiscriminatory. Will be free for government. A consultant's report will go to GISTDA's Board for implementation. The minister of Science and Technology approves.
Ukraine	Law of Ukraine on Space Activity, No. 503/96-VR. 1996.	Authorized. Some contained in statute.	None.
United Arab Emirates	Federal Act 20 (1991) (Aerial remote sensing.)	None	As per contract with satellite data providers and, by incorporation, national requirements to which the satellite data provider is subject.
United States of America	The 1992 Land Remote Sensing Policy Act National Defense Authorization Act for Fiscal Year 2005 The Communications Act of 1934	Bilateral US-Canada Agreement on Commercial Remote Sensing Satellite Systems 15 CFR Part 960 Licensing of Private Land Remote-Sensing Space Systems; Final Rule U.S. National Space Policy, October, 2006 White House, Office of Science and Technology Policy and National Security Council,	1. 1992 Land Remote Sensing Policy Act: 5622. Conditions for operation (b) Licensing requirements [for commercial systems] Any license issued pursuant to this subchapter shall specify that the licensee shall comply with all of the requirements of this chapter and shall— (1) operate the system in such manner as to preserve the national security of the United States and to observe the international obligations of the United States in accordance with section 5656 of this title; (2) make available to the government of

		February 2, 2000 Memorandum of Understanding Concerning the Licensing of Private Remote Sensing Satellite Systems U.S. Commercial Remote Sensing Policy, April 25, 2003	any country (including the United States) unenhanced data collected by the system concerning the territory under the jurisdiction of such government as soon as such data are available and on reasonable terms and conditions; (3) make unenhanced data designated by the Secretary in the license pursuant to section 5621 (e) of this title available in accordance with section 5651 of this title; § 5651. Nondiscriminatory data availability (a) General rule Except as provided in subsection (b) of this section, any unenhanced data generated by the Landsat system or any other land remote sensing system funded and owned by the United States Government shall be made available to all users without preference, bias, or any other special arrangement (except on the basis of national security concerns pursuant to section 5656 of this title) regarding delivery, format, pricing, or technical considerations which would favor one customer or class of customers over another. (b) Exceptions Unenhanced data generated by the Landsat system or any other land remote sensing system funded and owned by the United States Government may be made available to the United States Government and its affiliated users at reduced prices, in accordance with this

			chapter, on the condition that such unenhanced data are used solely for noncommercial purposes. 2. National Defense Authorization Act for Fiscal Year 2005, SEC. 1034. Nondisclosure of Certain Products of Commercial Satellite Operations. (a) Disclosure Prohibited.--Land remote sensing information may not be disclosed under section 552 of title 5, United States Code. (b) Land Remote Sensing Information Defined.--In this section, the term ``land remote sensing information''-- (1) means any data that-- (A) are collected by land remote sensing; and (B) are prohibited from sale to customers other than the United States Government and its affiliated users under the Land Remote Sensing Policy Act of 1992 (15 U.S.C. 5601 et seq.); and (2) includes any imagery and other product that is derived from such data. (c) State or Local Government Disclosures.--Land remote sensing information provided by the head of a department or agency of the United States to a State or local government may not be made available to the general public under any State or local law relating to the disclosure of information or records.

			(d) Safeguarding Information.--The head of each department or agency of the United States having land remote sensing information within that department or agency or providing such information to a State or local government shall take such actions, commensurate with the sensitivity of that information, as are necessary to protect that information from disclosure prohibited under this section. (e) Other Definitions.--In this section, the terms ``land remote sensing" and ``United States Government and its affiliated users" have the meanings given such terms in section 3 of such Act (15 U.S.C. 5602).
United Kingdom	Outer Space Act, 1986.	None	None
COOPERATIVE SYSTEMS			
CBERS (Brazil and China)	Complementary Protocol to the Framework Agreement Between the Government of the People's Republic of China and the Government of the Federative republic of Brazil on Cooperation in the Peaceful Applications of Outer Space Science and Technology on the	N/A	Summary: Currently under CBERS agreement, open access but possible movement to adopt other policies. Data downlinks licensed based on per-minute fee basis. China and Brazil may agree in a few special cases agree to transfer data free. Now includes Mozambique, Angola, and some other African countries. CRESDA and Brazilian ground

	Cooperation for the CBERS Application System, 2004. For the Government of the Federative Republic of Brazil For the Government of the People's Republic of China CBERS Data Policy		stations have unlimited access. Distributors are licensed. Independent price list for distribution solely within national market. Can not be exported abroad. INPE and CRESDA set international prices. General Considerations: The downlink data is open to any country or organization and is based on the conception that CBERS imagery will be distributed by licensed representatives who operates an application system infrastructure that performs data reception and processing. . . .Each ground station receives the image raw data and process it into image products, which will then be distributed to users. The licensing of CBERS data downlinks is based on fees which are charged in a per-minute basis. China and Brazil may, in a few special cases, upon mutual consultation, decide on the transfer of data free of charge. The ground stations operated by INPE in Brazil and by CRESDA in China have unlimited access to all data collected within their footprint. The policy for distribution of data collected by those ground stations will be defined by each operator. Licensing Policy For International Ground Stations (a) CBERS data reception, processing and distribution to other countries will be carried out by licensed representatives jointly appointed by CRESDA and INPE.

			(b) The licensed representative will commercialize CBERS data downlink to ground stations based on a annual fixed basis, based on a fee determined by INPE and CRESDA. The annual fee will be determined by the conditions of the ground stations, including geographical location and antenna footprint. Product Distribution Policy The commercial agreement between licensed representatives and distributors shall include the following: (a) The right of receiving, processing and distributing CBERS data shall be granted to the distributor by the licensed representative…… (f) Each distributor could set its native price list independently for distribution solely within its respective national market. Images distributed within the distributor's national market may not be exported abroad. (g) When distributing abroad, the distributor must refer to the international price list set by INPE and CRESDA.
COSMO-SkyMed and Pleiades (France and Italy)	Ratification and Execution of the Agreement Between the Government of the Italian Republic and the Government of the French Republic on Cooperation in the Field of Earth Observation, Done in Turin, 29th January 2001. Published in the Gazzetta Ufficiale (Official Gazette) 31st January 2004, no 25	N/A	1. The Parties are agreed on the following principles: a) The data requested by one or the other of the Defence Ministries shall belong to the Defence Ministry having requested the programming. b) For other data: i) the French Party is owner of the data generated by the optical component; I ii) the Italian Party is owner of

			the data generated by the radar component. 2. Civil and commercial distribution: In accordance with the common provisions on the use of data set forth in Article V, concerning the distribution and commercialisation of products derived from the dual-use satellite system, the Parties shall, in the course of Phase 1, define a common distribution policy. Each of the Parties shall designate a body to act as the interface with civil and commercial users, and to formulate, promote and distribute the data destined for civil and commercial users. (RE: Optical system. As further formulated pursuant to the Turin Agreement) CNES holds copyright License to use granted to defense, cooperating countries, and institutional users for non-commercial use full and exclusive license for data under responsibility of commercial operator. System resources, including data, allocation: 40% = institutional bodies less than 10% = defense

These charts are provided by the National Center for Remote Sensing, Air, and Space Law at the University of Mississippi School of Law. The information contained in this chart represents information as of January 3, 2007.

COMMENTARY

INSPIRATION TO HUMANKIND FROM SPACE LAW AND SCIENCE AND EXPERIENCE IN INDIA

Saligram Bhatt[*]

I. INTRODUCTION

This paper provides a contemporary perspective on space law and associated science that has created inspiration and enlightenment for humankind. We will discuss the current status of space law, look for the vision of humankind for space exploration, the dominant ideas that are enshrined in space law, and how space exploration has integrated global knowledge and promoted peace. We will also discuss space law and policy followed in India, and benefits derived from space applications in a developing country. India is a prominent member of the global community, engaged in space applications and international cooperation. Experiences by India are likely to help draw a road map for the global society for peaceful uses of outer space for the 21st century.

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II. SPACE LAW AND SCIENCE

Space law is a part of international law. Soon after space exploration started in 1957, the U.N. extended international law and the Charter of the U.N. to outer space—to cosmic frontiers. This was done through U.N. Resolutions that showed the common efforts of humankind to find law and order in this new frontier. Subsequently, other legal documents were developed. In general, space law has been shaped by the writings of writers and jurists. It has been carried forward through U.N. Resolutions and Declarations making up for customary international law based on consent and practice of States. Various conventions and treaties then followed.

It may be recalled that space exploration began as part of the International Geophysical Year programme in 1957, when States combined efforts for scientific exploration of the planet Earth. The scientists were keen to find out the geo-physical knowledge about the Earth. Later, a conference was held by UNESCO in 1968 on Biosphere Management. Therefore, space law has had an important interaction with space sciences that continues today as we advance in space exploration. The U.N. Committee on the Peaceful Uses of Outer Space has to this day two sub-committees, one on science, and one on space law. Therefore, in our observations in this paper we make an attempt to combine knowledge provided by leading scientists and jurists. In India, scientists have represented most perspectives on space exploration and hope to make national legislation in due course based on national experience. Space applications are becoming important for the national economy, as we shall see in this paper. I may mention that my association with space law and science is over forty years old. During this period I have seen space law develop from its inception in 1957. I have been associated with many scientists and jurists while in pursuit of the study of space law, and international law in general. Therefore, as a space scholar I shall attempt to present a balance sheet of a vision that humankind has produced for space exploration during the last fifty years. It seems to be an inspiring vision.

III. Vision Statement for Space Exploration

What is the vision and mission of humankind in space exploration? We will make a contemporary assessment which may be good for this century. Our assessment is based on past practice and contemporary human expectations. A leading jurist of our time, Professor Myres McDougal of Yale Law School who, along with his associates, helped shape modern international law in recent years, has said that human expectations make up for the definition of modern international law in an integrated and interdependent world society. Professors Harold D. Lasswell and Myres McDougal elaborate:

> In the sense of interdetermination with respect to all values, the whole of mankind presently constitutes a single community, however primitive . . . A global public order, thus affects the internal public order of its many constituent communities, and the internal public order of each constituent community, in turn, affects the global public order.[1]

This view has been shared by many scholars. Such a vision statement of ours in space exploration is likely to help promote the creative unity of humankind. This vision seems useful for the evolution of global society. Space law in particular and aerospace law in general has an important impact on global society. Presently we are concerned mostly with the psycho-social evolution of our civilization.

The theory of natural selection, stated by Charles Darwin, is interpreted based on international cooperation. The modern global biologist Rene Dubos has done pioneering research on human evolution based on cooperation. Along with Barbara Ward he wrote the Report to UN Stockholm Conference on Human Environment in 1972: *Only One Earth, The Care and Maintenance of a Small Planet*. Dubos makes a strong case for cooperation among the human species. He cites Darwin, "in

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[1] Harold D Lasswell and Myres S. McDougal, *Criteria for a Theory About Law*, 44 S. CAL. L. REV 362, 389 (1971). *See also* Myres S McDougal and Leon Lipson, *Perspectives for a law of Outer space*, 52 AM. J. INT'L L. 420 (1958), (defining the law of space, thus, "[w]hen law is conceived as a community's expectation about the ways in which authority will and should be prescribed and applied . . . ." *Id.*)

numberless animal societies, struggle is replaced by cooperation," and "all evolutionary phenomenon involve feedback processes between the organism, its environment, and its way of life."[2] Darwin himself said that humankind is endowed with reason and cooperative spirit. Space exploration has shown that a predominant feature of relations between States is mutual cooperation, based on mutual interest of States in a federal structure of world order. Another aspect of our vision statement is the extent that humankind has to control global technology and maintain harmony with nature. Historians like Arnold Toynbee have shown from a study of history that humankind can live for another 2000 million years, provided the global resources are used ecologically and with wisdom and global technology controlled.[3] And lastly, humankind has come to a stage when it needs to conserve nature and protect global environments. Conservation is a positive concept of space law and science. By utilizing laws of nature, humankind can better preserve Earth and its resources. Conservation can help global society to live a creative and happy life.

A. Objectives of Space Vision

The objectives of space vision are as follows: peace in space and peaceful uses of outer space, international cooperation, freedom and responsibility, sharing benefits from space and removal of global poverty, conservation of nature, a stable biosphere, and the progress of science and research on the laws of nature.

First, peaceful uses of outer space have been the first goal of humankind. It forms the fundamental principle of space law enshrined in the Outer Space Treaty of 1967.[4] Accordingly, military uses are not permitted. However, military personnel can be

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[2] Rene Dubos, *Human Nature: Man and his Environment*, *in* 1 BRITANNICA PERSPECTIVES 219, 235 (Chicago, 1968).

[3] *See generally* ARNOLD TOYNBEE, MANKIND AND MOTHER EARTH: A NARRATIVE HISTORY OF THE WORLD 641 (Oxford University Press, 1976).

[4] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

used for scientific uses of space. During the last forty years, no single country has sent nuclear weapons to space. No State has placed weapons in space or on the Moon. This augurs well for humankind. Global statespeople and all jurists and scientists must firmly resolve to keep space for peaceful uses for humankind. In the formative period of space law, some leading jurists like Professor Myres McDougal and his associates Professor Ivan A. Vlasic and Professor Harold D. Lasswell made a subtle distinction for the type of space activity. They called activities for "minimum order" in space when expectations for war-like activities are eliminated and peace maintained at all costs.

The space powers have shown what "minimum order" in space means. It is imperative for scholars to highlight this resolve of humankind. According to the aforementioned jurists, "optimum order" activities involve cooperation among States when world society can collaborate for a common agenda for space exploration. Humankind seems to have followed the "optimum order" of international cooperation extensively. Cooperation has become the leading habit of humankind. It is also a leading principle of international space law. It seems during the formative period of space exploration, statespeople from all countries took note of views from eminent academic societies and jurists. These views today form the important structure of space law. Scholars from India, along with scholars from advanced countries, took leading roles in the deliberations of the U.N. to enshrine these precious words in the legal documents prepared—the peaceful uses of outer space. Some of them included late Mr. V.K. Krishna Menon and Dr. K. Krishna Rao. The latter acted as Chairman of the U.N. committee for preparing the Liability Convention.[5] I had some interaction with both scholars. Mr. Krishna Menon as President of the Indian Society of International Law released my book in 1973: *Legal Controls of Outer Space: Law, Freedom and Responsibility, in the Indian*

[5] Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, T.I.A.S. No. 7762, 961 U.N.T.S. 187 [hereinafter Liability Convention].

Society of International Law.[6] This Society has helped spread knowledge about space law in India. It has held many national and global conferences.

The second objective of space vision is the principle of international cooperation. Space exploration is based on cooperation of humankind. This principle is largely included in the Outer Space Treaty of 1967. For example, the current efforts to make a space platform for space transport by shuttle is a joint effort by NASA, ESA, and the Russian Federation. The exploration of the Moon by *Chandrayaan-1*, launched on October 22, 2008 under the guidance of Dr. G. Madhvan Nair along with M. Annadurai and other distinguished scientists, has begun a great journey in space. The ISRO office in Gujarat Council of Science City in Ahmadabad informs that *Chandrayaan-1* is carrying, for the first time, ISRO scientific instruments in space for experiments to search for water, minerals and knowledge about the Moon and the cosmos in general. Amitabha Ghosh, an Indian scientist working in NASA, says that this mission will tremendously enhance India's brand value for space exploration. Dr. Madhvan Nair says that the mission will help increase the sophistication of space systems like INSAT and IRS. He stated that the mission was an exercise in cooperation with other developed countries. Narotham Sahoo the present Director of ISRO Ahmadabad Application Centre says that this Moon mission will start a new era in Indian space science education and research. George Joseph, a former Director Ahmedabad Space Application Centre who chaired ISRO's Lunar Mission Study, says the mission will be a great step in India's space odyssey. Some reports suggest that there is helium-3 available on the Moon that can help solve energy problems.[7] Almost a thousand

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[6] SALIGRAM BHATT, LEGAL CONTROLS OF OUTER SPACE: LAW, FREEDOM AND RESPONSIBILITY 372 (S. Chand and Co. Pvt Ltd 1973). The book has an introduction by Professor Quincy Wright. The global committee of scholars will always remember the pioneering work on space law by Professor Howard J. Taubenfeld and Professor Philip C. Jessup entitled, *Controls for Outer Space and Antarctica Analogy* (NY 1959). I had the privilege to work with Professor Taubenfeld as a Post-doctoral Fulbright Scholar at Southern Methodist University School of Law in Dallas, Texas from 1969-70.

[7] *See* A. Sethi and M. Kumar, TIMES OF INDIA (New Delhi, Oct 19, 2008). The cost of *Chandrayaan-1* is just about Rs 380 crores with 1,000 scientists working over a period of 3 years. *See also*, TIMES OF INDIA (New Delhi, Oct 26, 2008).

scientists are involved in this scientific venture, which augurs well for Indian science and global science. NASA often collaborates with Indian scientists. Former NASA Administrator Dr. Griffin had some words of appreciation for the Indian scientists: "You have in India wonderful technical schools—scientific, mathematics, engineering; a population that values education in terms of a way to get ahead in life, to improve oneself." He told this to *India Abroad* recently, a newspaper based in the United States. The cooperation between India and the United States include joint business programmes, civilian space programmes, satellite navigation, placing two NASA instruments in *Chandrayaan-1* to orbit the Moon, placing ground equipment in India for monitoring US Environmental Satellite, monitoring floods in India, helping with natural disasters, locating oil spills, etc. In February 2008, NASA and ISRO signed a framework agreement, replacing the one signed in 1997, to continue to work together in all avenues of space exploration, including human spaceflight. It may be recalled that there are several cooperative agreements among various States in different fields including satellite communications, etc. Many non-space countries, particularly in Africa, are not yet substantially associated in space cooperation. However, in due course, these States will be part of a process of global cooperation. For example, a global conference was held on November 17, 2008, which was sponsored by Tunis Science City and the recently formed International Academy of Astronautics where the present writer participates.

B. Freedom and Responsibility of States in Outer Space

Ever since space exploration started in 1957 during the IGY programme, humankind has accepted that space is free for exploration and does not belong to any one State. The freedoms of space include freedoms for use and scientific exploration. Space is taken as the province of all of humankind. It cannot be appropriated by any means. Indeed, this freedom concept in outer space was a high postulate of States not to bind humankind to Earthly environments. It fulfilled the quest of humanity to learn more about the cosmic frontier. The freedom spirit looks good today as well and for all time. It should help promote greater understanding of the cosmic frontier and Earth and overcome limitations imposed by national attitudes. Outer space is unlike air space which belongs to superjacent States, and this principle is enshrined in the Chicago Convention of 1944.

After fifty years of space exploration, the freedom spirit in space continues to inspire humankind. The freedom concept in space has had some interaction with the strict air law regime as we have seen. For example, global air transport is today liberalized with national airlines collaborating for economic benefits with foreign airlines. We have seen earlier how space regimes between States are combining for mutual benefits. Nevertheless, with freedom comes responsibility. All space-going States have the extraordinary responsibility to observe the laws of space. While exploring space, States need to behave as very responsible members of the international community.

These provisions for freedom and responsibility have been entered in space law documents and in the Outer Space Treaty of 1967. The Liability Convention of 1972 further lays down how States make up for the damage done to other States and persons involved on Earth or in airspace or outer space.[8] This relationship of law, freedom, and responsibility forms a triangle that I attempted to work upon in my Ph.D. thesis from 1964 to 1968. The Outer Space Treaty was then being drafted. The title of my book published later in 1973 is *Legal Controls of Outer Space: Law, Freedom, and Responsibility*. It has an introduction by the late Professor Quincy Wright with whom I had my viva for over three hours along with Professor Mason Willrich at 1970 in the University of Virginia. My thesis advisers were Dr. Nagendra Singh, Judge of ICJ, and Professor R.P. Anand. Professor Anand had returned from Yale Law School to JNU India after working with Professor Myres McDougal. The latter had published a book in 1963 with Professor Ivan A. Vlasic and Professor Harold D. Lasswell.[9] These jurists had been debating on space law in the academic sessions of ASIL during 1956 and 1957, almost

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[8] Liability Convention, *supra* note 5.

[9] MYRES MCDOUGAL, LAW AND PUBLIC ORDER IN SPACE 1037 (New Haven, Conn. London, 1963).

coinciding with the entry of Soviet *Sputnik* in outer space. I wrote a review-article in the *Indian Journal of International Law*, New Delhi on the book by Professor McDougal entitled "Reasonableness as the doctrine of space law."[10] The authors recommended that in the new field of space law "reasonableness will be key to decision-making." Professor Carl Christol had also published a book that I reviewed together in the above-mentioned article.[11] Reasonableness for decision-making was the theme in both books as the basis for determining then emerging space law.

It seems reasonableness is true in contemporary period as well in resolving problems where views held by States are not unanimous. Therefore, reasonableness can guide us in seeking a balance between freedom and responsibility in space exploration. Reasonableness, for example, will help us wipe out global poverty and disease, taking into consideration that this work is of common interest to humankind. Justice Benjamin N. Cardozo wrote *The Nature of Judicial Process*, formed from lectures delivered at Yale University in 1961. Justice Cardozo made a visionary statement that needs to be quoted fully here. He says:

> "In numberless litigations the description of the landscape must be studied to see whether vision has been obstructed, whether something has been done or omitted to put the traveler off his guard. Often these cases and others like them, provoke difference of opinion among judges. Jurisprudence remains untouched, however, regardless of the outcome. Finally there remains a percentage, not large indeed, and yet not so small as to be negligible, where a decision one way or the other, will count for the future, will advance or retard, sometimes much, sometimes little, the development of the law. These are the cases where the creative element in the judicial process finds its opportunity and power. It is with these cases that I have chiefly concerned myself in all that I have said to you. In a sense it is true of many of them that they might be decided either way. By that I mean that reasons plausible and

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[10] *See* Saligram Bhatt, *Reasonableness as a Doctrine of Space Law*, 6 INDIAN J. INT'L. L. 395-404 (1967).

[11] *See* CARL Q. CHRISTOL, INTERNATIONAL LAW OF OUTER SPACE 553 (Washington, DC, 1966).

> fairly persuasive might be found for one conclusion as for another. Here come into play that balancing of judgement, that testing and sorting of considerations of analogy and logic and utility and fairness, which I have been trying to describe."[12]

Thus Justice Cardozo defines reasonableness very well, in a way that helps determine the decision process in courts.

C. Space Benefits and Removal of Global Poverty

Humankind is at the threshold of a new era in space exploration, at a time when sharing economic benefits and removing global poverty is possible. Space exploration has also been a great scientific revolution in the history of humankind. Space sciences have integrated knowledge. Also new knowledge is being added from space sciences. A single satellite can send education information worldwide. A remote-sensing satellite can give information of vast oceans and land areas in our computers while sitting in our rooms. Thus space exploration uses less costly and user friendly technology, like in *Chandrayaan-1*, for economic benefits and progress of science. Space provides information by GPS to millions of cars that are scattered all over our precious land space. This help to humankind was not anticipated as much in the early period of 1957. India, for example, started a space programme in November 1963 by sending *Nike-Apache* from Thumba launching station for upper atmospheric observations. It now sends launch vehicles to orbit the Moon, all in a period of forty-five years. The U.N. held an important conference in 1999 in Vienna called UNISPACE III. The conference was held to utilize enormous space benefits, especially for the developing countries. Professor U.R. Rao from India, a distinguished scientist, was the Chairperson. I had occasion to attend this as a Commentator to provide input on a paper by Professor V. Kopal on improvements needed to space treaty of 1967.[13] The U.N. brought out a document for a work-

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[12] *See* BENJAMIN N. CARDOZO, THE NATURE OF THE JUDICIAL PROCESS 165 (5th Indian reprint, Yale University Press, 2004) (1961).

[13] *See* UNISPACE III, *Workshop on Space Law in the 21st Century* 1-12 (Vienna, Austria, July 20-24, 1999).

shop on Space Law in the 21st Century. The workshop was coordinated by the International Institute of Space Law. The participants included Professor Vladimir Kopal, Mr. H. Peter van Femena, Professor Francis Lyall, Professor J. I. Gabrynowicz, Mr. Christian Roisse, Professor Paul B. Larson, Professor Dr. Peter Malanczuk, Dr. Lubos Perek, and most prominent members of the IISL. The present writer presented to the conference a 12-page paper entitled "Existing United Nations Space Treaties: Strengths and Needs."[14]

The world has seen tremendous benefits provided by space exploration. The Space Division of UN in Vienna had prepared a volume entitled, "Space Benefits for Humanity in the Twenty-First Century" for the conference.[15] The conference also adopted a resolution on Principles on Space Benefits for humankind. These principles had been approved by the UN Space Committee. Space benefits are intended to improve the quality of life and remove global poverty. The space-going nations have agreed to share space benefits for humankind.

We are thus making reflections on emerging space law and science for a beautiful world order of today and for civilization tomorrow. Global agricultural science, for example, when made available, especially in Africa, and when combined with remote-sensing space sciences will help remove poverty in Africa and elsewhere. Humankind has great expectations. Patience and international cooperation among States and their people will be useful. Speaking in the UN General Assembly, Fourth Committee, the United Sates delegate highlighted the sharing of space benefits and the adoption of Principles on Space Benefits by consensus decision in the UN space committee. He said it was a great step for "the quality of life around the world." The delegate from India said that it has remote-sensing satellite on a

[14] *See* UNISPACE III, *Conference for Space Benefits for Humanity in the Twenty-first Century* (Vienna, Austria 1999); Saligram Bhatt, *Space Law in the Twenty-first Century*, IISL WORKSHOP SESSION 1 (comments by Saligram Bhatt on discussion paper by Vladimir Kopal).

[15] *See* UNISPACE III, *Space Benefits for Humanity in the Twenty-first Century*, *in* THIRD UNITED NATIONS CONFERENCE ON THE EXPLORATION AND PEACEFUL USE OF OUTER SPACE. U.N. Doc. A/CONF.184/BP/13, at 316 (1999).

global scene. Thus, this objective of our space mission of space benefits seems to be of great interest to humankind.

D. Conservation of Nature and a Stable Biosphere

Conserving nature is an important goal of our space exploration mission. Remote-sensing and communications satellites have made space a window for monitoring the biosphere, and ensuring the conservation of nature. These functions have become essential for planning economic development on the one hand and protecting global environments on the other. In the 57th IAF conference held in 2007 in Hyderabad, the present writer presented a paper during the deliberations of the IISL entitled "Space Law and Nature Conservation." Dr. Anna Maria Balsano, suggested nature conservation as a theme for a Colloquium of IISL. Humankind has all the dimensions of this subject of conservation to move forward towards a global paradigm, of an ecological approach to aerospace law. An ecological approach will ensure nature conservation. It will provide an ecosystem approach to nature resources management. These practices have already started the world over. Conservation will help shift to ecological economics, in addition to economics of growth rates. It will help us comprehend the global ecological balance. We will understand the biosphere reserves better and keep the biosphere stable. Global warming can be addressed by use of new sources of energy that are already in the pipeline, including solar and nuclear energy. A recent experiment by the European Centre for Nuclear Research in Switzerland smashed protons against each other at a great speed thereby releasing fusion energy may provide cheap fuel in the long run, with no impact on the environment.

The next global conference by the U.N. may be a conference on the conservation of nature. Such a conference on nature conservation will provide benefits to humankind and stability to the biosphere, and space law will help provide a roadmap for planning and implementing conservation of nature, ecological economics, and harmony with nature. In this connection, I have published two articles in McGill University *Annals of Air and Space Law* vol. (4) in 1979, and vol. (5) in 1980, then edited by

Professor N. M. Matte, the former on “An ecological Approach to Aerospace Law” and the latter entitled “The Contribution of Aerospace Law to Evolution Man and Global Society.” These two articles, written almost thirty years ago, seem to need fresh scholarly attention due to the impact of global technology on environments and on human evolution. References have been made to my article on evolution in the *Annals* in 1980, along with another article by Professor Karl-Heinz Bockstiegel.

E. Space Exploration and Research on Science and Laws of Nature

Our next goal for our mission in space is the quest for research in science and the laws of nature. To Einstein, science was a search for discovering the hitherto hidden laws of nature.[16] Einstein, along with Infeld Leopold, wrote a book entitled, *The Evolution of Physics: The Growth of Ideas from Early Concepts to Relativity and Quanta*.[17] They observed that “[p]hysical concepts are free creations of the human mind not determined by external world.”[18] These celebrated scientists recall that during the second half of the 19th Century new and revolutionary ideas were introduced in physics that opened a new philosophical view different from a mechanical view. This was a result of the works of Faraday, Maxwell, and Hertz; all forming a new picture of reality.[19]

Einstein said that nature is partly comprehensible. In space exploration, it seems we are open to new research regarding the laws of nature and the unknown laws of nature. This search is magnificent for scientists and humankind in general, and it involves the entire biosphere on the one hand, and the cosmos in general, on the other. Dr. E.C.G. Sudarshan stated in his paper that science is a search for the universe.[20] Dr. Sudarshan has

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[16] *See* ARTHUR KOESTLER, THE ART OF CREATION 241 (London, 1964).

[17] *See* ALBERT EINSTEIN & INFELD LEOPOLD, THE EVOLUTION OF PHYSICS: THE GROWTH OF IDEAS FROM EARLY CONCEPTS TO RELATIVITY AND QUANTA (Cambridge, London, 1961).

[18] *Id.* at 31.

[19] *Id.* at 125.

[20] ECG Sudarshan, *Temper of Science* (Aug. 1974).

also written some outstanding research articles on science and the laws of nature. These include *Natural Law and Order*, *Evolution of Mind*, *The Indian Scientist – Some Reflections*, *Recent Developments in Theoretical Physics*, *What are Building Blocks of Nature?*, *Indian Metaphysics and Philosophy of Science*, *Patterns in Universe*, *Space Time Aspects in Vedanta*, *Knowledge, Process, Wisdom and Science*, and *Bose-Einstein Statistics 1974* (incidentally the recent experiment by nuclear scientist in Switzerland put forth the basic contribution of Indian scientists Satyen Bose and the Boson particle). Professor Sudarshan is engaged in research at Texas Christian University, Department of Particle Physics, and the Indian Institute of Science, Bangalore. He has made basic and landmark discoveries in the law of universal weak interaction. Based on his research some scientists have obtained the Nobel Prize. Professor Sudarshan, himself, is awaiting due recognition for his research.[21]

We can understand how ignorant humankind has been without space exploration. We may be at the starting point of a long journey for knowledge. The scientists in NASA and those in India seem to know this aspect well and are excited with mutual collaboration. I had occasion to meet some scientists from the E.U. that were working in India trying to establish a technological university in collaboration with Directorate General of Civil Aviation (DGCA) India for aerospace engineers in India. This was in 2005 and 2006. The message was clear: look for new technology and science for aerospace exploration. Indeed, Dr. Madhawan Nair the present Secretary Department of Space and Chairperson ISRO is the chairperson of the Aeronautical Society of India that looks after combined research in aerospace field. Long ago, Sir Federick Tymms was the DGCA in India who drew the scientific map for expansion of civil aviation in India. His one article on "freedom of air" is read even today among scholars.

While discussing space science and law, and the laws of nature in general, it may be useful to integrate knowledge from the field of natural sciences and social sciences including space

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[21] *Id.*

law. A book on global warming written by a distinguished scientist, Sir John Houghton, Emeritus Professor at Cambridge, *Global Warming: The Complete Briefing*, 2004, recommends four points for scientific research in the field of environment.

First, we follow an integrative holistic approach that considers the interactions between multiple stresses and between various possible solutions. Such an approach seeks to integrate perspectives from both the social and natural sciences. The second point Professor Houghton makes is to remember that in scientific research, it is necessary to find solutions and not merely raise questions. Applied research is as important as identifying problems, he says. The third requirement is that scientists share experience with stakeholders, so that stakeholders accept their observations. And fourthly, scientists must see themselves as facilitators of social learning rather than as sources of social guidance. As space law and science has changed world society rapidly, with impact on value systems and lifestyle, the above observations from Professor Houghton seem of general interest. His book is written very well on the subject of global warming and provides great vision for humankind. Science today has become the study of an integrated knowledge. We need to discover links between various scientific disciplines and other areas of knowledge. Another distinguished scientist Neils Bohr called for the discovery of "unity of science" by combining science, art, and philosophy. Professor Gerald Holton, Professor of Physics and Chair of the History of Science, Harvard University, in his fascinating book cites Neils Bohr, the Nobel Laureate: "The aim of all argumentation is to emphasize that all experience whether in science, philosophy, or art, which may be beneficial to mankind, must be capable of being communicated by human expression, and it is on this basis that we shall approach the question of unity of knowledge."[22] Most modern scientists, including Professor Stephen Hawking, support a holistic view of knowledge.

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[22] *See* GERALD HOLTON, THE THEMATIC ORIGINS OF SCIENTIFIC THOUGHT: KEPLER TO EINSTEIN 136 (Harvard University, 1973).

IV. PERSPECTIVES ON THE OUTER SPACE TREATY (OST)

The Outer Space Treaty of 1967 is the charter of international law for space exploration.[23] It governs activities of humankind in space. It contains principles of space law that have been followed by States. The Treaty's preamble reminds that space exploration has inspired humankind, involves common interests and benefits of all people, and promotes international cooperation and mutual understanding. These ideas form a vision statement made by States. The Outer Space Treaty lays down some important principles of space law that form the foundation for space exploration. It says that exploration is for the benefit of humankind. Space is the province of all humankind. It is free for use and scientific investigations. Outer space cannot be appropriated by any means. Exploration and use is to be conducted according to international law and the Charter of the U.N. No nuclear weapons can be put in the orbit of space. The Moon and other celestial bodies will be used for peaceful purposes. It lays down international responsibility of States and defines liability for any damage caused to other States. It provides for the national jurisdiction of States over space objects the State registers. Further, it calls upon States to promote international cooperation in space activities, provide mutual assistance, and avoid contamination and damage to space environments.

The U.N. held a workshop at the UNISPACE III conference in 1999 in Vienna to discuss some needed amendments to the space treaty. The predominant concern is to include private entities that take part in space entities for regulation under the Outer Space Treaty. Besides, there is need to consider drafting a general convention on space exploration like the Chicago Convention on air law of 1944. Such a convention may include the existing space treaty and other four treaties regarding the rescue of astronauts, registration of space objects, the liability convention, and the Moon treaty. The new convention will also include five Declarations on various subjects agreed to by the States. Such an overall convention will give shape to the U.N.

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[23] Outer Space Treaty, *supra* note 4.

space organization for space activities consisting of existing space powers, and some States based on geographical regions. It may have a Global Space Navigation Commission that would take care of scientific and technical problems and issues of international cooperation. The U.N. space organization will be a Specialized Agency of the U.N. with a General Assembly of all member States, with a Secretariat like the present space division, the Legal Bureau, Space Transport Bureau, etc. The present space committee can be merged with the organs of the new proposed space organization. The legal sub-committee becomes the legal bureau, and the scientific committee becomes the space navigation commission. Under the new legal set-up, the UN Space Organization can issue amendments to various legal treaties, conventions, and declarations. It can also initiate new technical and legal regulations like the Standards and Recommended Practices in the Chicago Convention of 1944. Dr. Nandasari Jasentuliyana has suggested introducing this process for ongoing space legislation. The present situation does not help the development of enormous space legislation, both technical and legal. We have to wait to call the U.N. General Assembly conferences to deal with legislative and technical matters. Such global conferences can be reserved for making global policies and making a global agenda for space exploration, especially when humankind and States have had very good experience for space cooperation. Space law in general provides an opportunity for initiative by individual States as also cooperation between many States. There can be a global agenda by humankind for space exploration objectives. I suggested a common agenda for humankind quite early in 1980, which I may cite here for general interest. In a new perspective of our enquiry, aerospace law, in addition to its traditional role, has some new areas of investigation. For example, the search for the reality of nature, the hitherto undiscovered laws of nature as Einstein says, the unity of knowledge, relationship of life on Earth and other planets, futurology, climatology, cosmology, etc.[24] We have seen above how cooperation helps space exploration in a world of lib-

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[24] *See* Saligram Bhatt, *Contribution of Aerospace Law to the Evolution of Man and Global Society,* 5 ANNALS OF AIR AND SPACE LAW 309 (McGill University, 1980).

eralisation and privatization. When compared with aviation law, and admiralty law, space law has developed mainly because of the cooperation between States and the inspiration provided by science and its vast applications in space exploration. Space observation has also helped global peace, disaster management etc.

The main issue is to circulate a new draft of an international space convention to States for the proposed U.N. Space Organization and to obtain comments from the States. With a large consensus among space powers and other States, such a global space organization will make space exploration smooth and better coordinated. Additional conventions and declarations can be worked out with cooperation between States, like exploring Mars. There can be a convention for cosmology, the science involving the interaction of space law and space sciences. All these developments are new projections in space law. This is new knowledge for humankind.

V. SPACE LAW AND APPLICATIONS IN INDIA

A. India's Space Programme

India provides a good example of a developing country that understands space law very well and has made useful and prudent use of space applications to transform India into a leading economic state. India began its space programme with a small sounding rocket to probe the upper atmosphere in 1963. Since then it has come a long way and can compare well with other space powers. The Indian scientists have worked with great humility and vision. They are great people of science, probably among some of the best in the world. I look upon them as seers. They are quietly transforming the economic and social life of the Indian people and are keen to remove global poverty. They seem ready to help humankind with their knowledge and their philosophy of life. A long time ago, another Indian seer, Rabindra Nath Tagore, said that in ancient times India from the East collaborated with the West in a spirit of harmony and love. That blending of East and West is taking place in our time as well, to provide harmony and balance in world society. That seems the policy in India to help humankind with knowledge from space science. One of these scientists, Professor U. R. Rao, has joined with Professor M. S. Swaminathan, the world known agricultural scientist, to spend Rs 1200 billion for another revolution for agriculture development in India and in the future India can expect to export food wherever needed in the world and better feed its own poor.

Other Indian pioneers in the field of space are: Dr. Vikram Sarabhai, Dr. Satish Dhawan, Professor Yashpal, Professor U.R. Rao, Professor A.P.J. Abdul Kalam, Dr. K. Kasturirangan, and Dr. G. Damodharan Nair. To date, the *Chandrayaan-1* project has been launched on October 22, 2008, for the Moon orbit. This launch has great expectations for the study of science in general, science about the lunar resources, knowledge about the cosmic frontier and as Dr. Madhawan Nair says, strengthening the *INSAT* programme for television, radio, telecommunication and meteorological services, and *ERT* (*Earth Resources Technology Satellite*) for remote sensing for Earth resources, and other collaborative programmes with other countries. On space applications, India presented an interesting document to UNISPACE III conference. These applications include space transportation systems, operational Indian space systems, industry interface, international cooperation, scientific knowledge of the Earth and its environment, the environment and natural resources and remote sensing, navigation and precise location system, space communication applications, information needs, and global approach. It also includes space efforts in India and the future perspectives. The future perspectives include space technology for finding solutions to problems of humanity and society, socio-economic development of the country, partnership with Indian industry, academia and user community to realize the goals and objectives of cost effective space technology, commercialization of technological capabilities for global market expansion, human resources development as also research and development in science and technology and space programmes.[25] Some major space ventures by India are: the satellite television

[25] *See* U.N. Conference on the Exploration and Peaceful Uses of Outer Space, June 25, 1999, *National Paper of India*, U.N. Doc. A/CONF.184/NP/35.

for education; in the 1970s for the purpose of agriculture, family planning, health, and hygiene for about 2400 villages in India; the *INSAT* (*Indian National Satellite*) in the 1980s for television, radio, telecommunications and meteorological services: *Earth Resources Technology Satellite* in 1970s that has developed into remote sensing satellites. India has a collaborative programme with the U.S., ESA, and the Russian Federation, etc. In 2004, a conference was held in India for India-USA cooperation in space sciences, space applications, and commerce.

B. Space Law in India

India has been actively involved in the development of space law in the U.N. since 1958, when an Ad Hoc Committee for Outer Space was formed. Thus, being an active member of the U.N. space committee and an active Member to promote international cooperation and having taken part in space exploration in early 1975, India has accepted the five space treaties and the five space declarations. This information has also been presented in an article recently.[26] The authors inform that ISRO is likely to draft new space legislation for national purposes in view of vast space applications, the practice of some other States, and to meet national social and economic needs. The private sector is also ready to provide help for more trade and commerce that requires national legislation.

VI. SOME CONCLUSIONS ON INSPIRATION FROM SPACE LAW AND SCIENCE

We have seen that space law is the common law of humankind for space exploration and use for common benefits. Space law and science have integrated knowledge so that global resources can be used more economically and ecologically. The mission in space activities is to seek peaceful uses of space, promote international cooperation and help between States, remove global poverty for which there is an excellent chance to utilize global resources with new scientific and technological

[26] *See* Mr. K. R. Sridharan *in* 93:12 CURRENT SCIENCE (Dec. 12 2007).

insights, and study more about the laws of nature with humility and promote harmony with nature.

The conservation of nature remains an important goal for space exploration. The academic institutions have an important role to highlight this inspiration to humankind. The Preamble of the Outer Space Treaty begins with the words that space exploration provides inspiration to all. Professor Arnold Toynbee, in his extensive study of history entitled *The Inspiration of Historians*,[27] refers to the challenge and response theory in human history. He says that all true history is contemporary history. Thus, we observe that currently the world society is responding to the challenges posed by combining space law and science to solve problems of global poverty, global warming, protect global environments and produce harmony with nature and harmony among nations. Space law and science are essentially based on international cooperation. I would like to recall what H.G. Wells said long ago in his *Outline of History*. "There are people who seemed to imagine that a world order and one universal law of justice would end human adventure. It would but begin it."[28]

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[27] *See* ARNOLD TOYNBEE, STUDY OF HISTORY, VOL. X: THE INSPIRATION OF HISTORIANS (1963).

[28] *See* H. G. WELLS, 2 OUTLINE OF HISTORY 606 (London, 1920).

COMMENTARY

WHEN FRANCE PUTS ITS OWN STAMP ON THE SPACE LAW LANDSCAPE

Comments on Law No. 2008-518 of 3 June 2008 Relative to Space Operations

Lucien Rapp[*]

1. Since the start of the space adventure, France has been a worldwide power; the number three space power, we are now told.[1] And yet, until Law No. 2008-518 of 3 June 2008 relative to space operations[2] was passed, it was the only one of these powers lacking space legislation.[3]

2. However, this this does not mean, however, that space activities in France have been going on outside of the law. In fact, they were still subject to international treaties and, in particular, to the three major applicable agreements: the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies,[4] the Convention on International Liability for Damage Caused by Space Objects,[5] and the Convention on Registration of Objects Launched into Outer Space.[6]

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[1] In this field, like in many others, emerging countries (for example, China and India) could have changed this traditional ranking.

[2] *See* Law No. 2008-518 of June 3, 2008, Journal Officiel de la République Française [J.O.] [Official Gazette of France], June 4, 2008.

[3] The States without space laws are now by far the fewest in numbers. *See* Ministère délégué recherche et nouvelles technologies, *The Evolution of Space Law in France* (Feb. 2003).

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

[5] Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187.

[6] Convention on Registration of Objects Launched into Outer Space Nov. 12, 1974, 28 U.S.T. 695, 1023 U.N.T.S. 15.

3. This situation could have continued. But though it has not resulted in major problems up to now, the absence of a space law was far from satisfactory. From a purely legal standpoint, the French State assumes particularly significant international liability as a launching State according to the terms of article VII of the Outer Space Treaty, the provisions of which are very general:

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

This liability is all the greater since in the absence of a national law, other provisions of national law could amplify its scope, notably in case of damage caused to third parties. And the contractual operations attempting to sidestep this liability came up against the obvious limits of the ever more refined legal protection that community law has established over the course of recent years for the benefit of victims.[7]

4. While not optimal, the absence of a space law was acceptable in the relatively closed world of still-experimental activities dominated by States and carried out, under their direct control, by public institutions; in France, for instance, by the *Centre National des Etudes Spatiales* (National Centre for Space Studies).

5. In recent years, however, and like many other activities traditionally controlled by the State, space activities have been transformed under the influence of a threefold movement, the combined effects of which have grown in scale:[8]

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[7] To this end, *see infra* ¶¶ 74 and 75.

[8] Regarding these movements, see in particular the elements of the first part of *For a legal Space policy*, Documentation Française (2006).

- *Marketing*, with the usages of space becoming ever more numerous as space activities left the experimental phase behind;
- *Privatization*, with the State now being no more than a minor player in a universe that is now dominated by legal entities governed by private law; and
- *Internationalization*, as it is no longer possible for launch sites, very coveted like other rare resources, to be "*sanctuaried*" or even "*patrimonialised*" by States as they had once been.

6. The absence of rules—or even procedures—in this area ended up becoming an inconvenience that could not be compensated by the provisions of international agreements; this is all the more true as the use of space has become strategic, and by not providing itself with a legislative instrument that would allow it to conduct a true space policy, the French State ran the risk of progressively letting the other powers, and notably the emerging powers, carry out their policies and protect their interests and those of their nationals.[9]

7. The heights were reached when the French State received a foreign operator's request to use the Kourou launch site. There was no procedure organising the conditions for this access, though it was impossible for the French State to use this argument in order to oppose the request that it had received. However, accepting such a request also meant assuming the launching State's liability, including and one might even say especially, with regard to third parties, for operations that require a minimum degree of precautions.

8. Recognising the inconveniences of such a situation, the French State therefore carried out, in only a few years, significant study work in order to produce a space law. Within the framework of a Ministry of Research, this work began with the establishment of three working groups, the conclusions of which led to an important symposium on 13 April 2003.[10] It then con-

[9] It is significant to note that the adoption of the French space law immediately resulted in bilateral discussions between France and the United States of America.

[10] *See The Evolution of Space Law in France, supra* note 3.

tinued on the basis of a mission letter from the Prime Minister to the State Council, for the purpose of the preparation of the law's text; this letter led to the set-up of a working group chaired by Ambassador Blot. This group then met for more than a year, heard all of the stakeholders, produced a report published by the *Documentation française*[11] and, in particular, prepared the text of a bill that was ratified by the State Council's consultative bodies. All that remained was for the Government to assume the draft submitted to it and to bring it before Parliament, which was done on 25 April 2007.[12] The debates in both assemblies were short, all the more so since the bill governing space operations was the subject of fairly broad consensus.[13] After shuttling back and forth, they led to the text of the law passed on 3 June 2008.

9. This law is a founding text, requiring clarification by several State Council decrees, notably because it is relatively short (a mere thirty articles). Despite the technical nature of its subject, the text is clear and quite explicit in spite of a few legalisms, and it can therefore be considered as operational, in the sense that its implementation should not give rise to major interpretation difficulties.

Of course, it does not settle all questions, but it establishes the bulk of what is now necessary for the French State to protect its interests and those of its industry. While not claiming to handle the paradox, the nuisance effect that could result from the adoption of a text relative to the previous situation of the absence of a law, has been reduced to a minimum.[14]

10. Setting aside the provisions of Articles 22 to 25 that govern the system applicable to inventions carried out or used in space aboard spacecraft that are subject to French jurisdiction[15] or that require a prior declaration system for operations

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[11] *See* State Council Studies, Documentation française, *For a legal policy for space activities* (2006).

[12] *See* Bill No. 297.

[13] On the debates, *see notably* the legislative file accessible on the senate's site, Bienvenue au Sénat [*Welcome to the French Senate*], *available at* www.senat.fr (last visited Mar. 19, 2009).

[14] This opinion is not shared by all operators, however.

[15] By making them subject to French law (Intellectual Property Code).

involving the collection of data originating in space, carried out in France,[16] the contributions of the law of 3 June 2008 are *threefold*:

- the law *requires prior authorisation for the activities of operators* that entail the liability of the French State in its capacity as a launching State (I):
- it *establishes a control system for these operators and their activities* by means of judicial policy or administrative measures which, though inspired by other economic sectors, are nonetheless very original (II)*;*
- it *organises the system of liability resulting from space operations*, in particular vis-à-vis third parties (III).

11. This having been done, the law puts its own stamp on the French space landscape, assigning a place and missions to each party.

I. THE LAW OF 3 JUNE 2008 REQUIRES PRIOR AUTHORISATION FOR THE ACTIVITIES OF SPACE OPERATORS THAT ENTAIL THE LIABILITY OF THE FRENCH STATE IN ITS CAPACITY AS A LAUNCHING STATE (I)

12. In the absence of a space law, the activity of space operators was basically unrestricted. This was particularly so since, in truth, it was unknown to French national law, which was unaware of the expression "space operator" and also that of "space operation."

The set-up of a prior authorisation system could not fail to bring up the question of the competency and powers of French lawmakers, not only with regard to the Constitutional Council's case law, but especially with regard to community law. While there is no longer any doubt that "the freedom to act is neither general nor absolute" and that lawmakers can apply any limits to it that are considered to be in the general interests, "provided

[16] These provisions elicit no particular comments. They can notably be explained by the concern to exercise control over these collection operations that are simultaneously subject to the right of personal portrayal, compliance with the property right and the security policy for the national territory.

that these limits do not distort the scope,"[17] the set-up of a prior authorisation system obviously collided with the EC Treaty's principle of freedom of movement.

Fortunately, the case law of the European Court of Justice is very finely shaded, as it accepts the possibility of restricted national regulations that are "justified by urgent reasons of general interest."[18]

It is also necessary for the restrictions provided by the national law to remain *in proportion with the desired objective*, which would imply that the established mechanism must be contained in terms of its *scope* (A) and organised in terms of its *provisions* (B).

A. The scope of the new prior authorisation system

13. It relates to *space operators* but, even more so, to their "space operations" according to the combined provisions of articles 1 and 2 of the new law.

14. According to the definition provided by the law's article 1-2°, "space operators" must be understood as: "any natural person or legal entity carrying out a space operation under his/her liability and independently." This definition is reminiscent of that of a transport operator, and it should logically lead to the categorization of a contract signed with a space operator as a *work contract*. It offers the advantage of *simple* and *objective* criteria that will be able to adapt to many situations while allowing, notwithstanding the dissociation of the property system relative to the object from that of the operation's conduct or even from that of the service order, the identification of a single economic operator, subject to the authorisation.

While it is not excluded that uncertainties remain in certain situations (to a certain degree, does a subcontractor not carry out its activities under its own liability and independently?), it is useful to note that a comparable or equivalent defi-

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[17] *See* Law No. 89-254 of July 4, 1989, Journal Officiel de la République Française [J.O.] [Official Gazette of France], modifying Law No. 86-912 relative to the application provisions of the privatization laws 41, Constitutional Council (Jul. 4, 1989).

[18] *See, e.g.,* ECJ 20 February 2001, Analir, add. C-205/99 Rec. p.I-1271.

nition is found in other space legislation, for example in the Belgian legislation.

15. The choice of this definition explains the indication in the law's Article 3, relative to the hypothesis of the transfer of control of a space object to a third party. Insofar as the French State can be held liable in both cases in its capacity as the launching State, it was natural that an authorised operator's transfer of the control of a space object should be subject to authorisation in its turn, in the same way as the reverse hypothesis of a French operator's plan to acquire control of a space object that has not yet been authorised.

16. Space operations must be understood as meaning not only the activities defined in the law's Article 1-3°, but also the ones listed in Article 2.

17. The former are broadly covered: "any activity consisting of the launch or attempt to launch an object into outer space or to provide control of a space object while it is in outer space, including the Moon and other celestial bodies, as well as, if relevant, during its return to Earth." Strictly speaking, this therefore consists of space activities in the strictest sense, thereby excluding applications made of them and that are generally referred to as "space usages." Satellite television or radio, remote guidance or observation, and Internet by satellite are therefore not "space operations" according to the new law, and therefore do not fall into its scope; this is confirmed, on the contrary, by the definition of space damage given in Article 1-1°, which stipulates "with the exclusion of the consequences for users of the usage of the signal emitted by such object."

From the above definition, we further note that no distinction is introduced between *civilian* activities and *military* activities, which can be understood by the fact that military activities can give rise to the French State's liability (an essential argument for the establishment of a prior authorisation system) and that they are often partially related to civilian activities, to which they are sometimes inextricably linked. Customizing the legal system would therefore not have been easy.

18. The latter fall into the field of the French State's *international liability* as a launching State. In an effort to be compliant with the aforementioned case law of the European Court of

Justice,[19] it was indeed necessary to be able to claim "urgent reasons of general interest."

As such, we find the two major situations generally identified by the international agreements, and in particular by the Convention of 29 March 1972:

- those corresponding with activities *undertaken from French territory* or *using installations placed under French jurisdiction* (whether carried out by French nationals or not); and,
- those corresponding with activities *undertaken from a foreign territory* or *using installations placed under foreign jurisdiction,* by *French* nationals or *on their behalf*.

19. From this latter point of view, we note the clarifications provided by the law's Article 2 on one's capacity as a French national. It includes natural persons holding French nationality and legal entities having their head office in France. Lawmakers therefore chose a somewhat lesser position when compared with the American law, which includes legal entities having their head office in a foreign country, but which are controlled by American nationals (*controlling interests*).

B. The provisions of the new prior authorisation system

20. The authorisation system set up by the law of 3 June 2008 is intended to allow the French State to exercise control over the activities of operators likely to result in its liability as the launching State.

21. If the law is relatively quiet regarding the procedure for the delivery of authorisations, this was seemingly intentional. Not only do the details of this procedure fall within the purview of regulatory authorities, but in so doing, Parliament has wisely authorised a degree of flexibility in the determination of these details.

We will see that this is not the only place in the law where it has done so.

The new law is evasive on this point, and does not indicate who is this *administrative authority* that it mentions at every

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[19] *Id.*

turn as being the competent authority, thereby leaving the door open to all kinds of possibilities:

- the *minister for space*;
- a *central government director* within this ministry;
- an *independent regulatory authority*, similar to the one being appointed with regard to railways.

22. With this in mind, the law of 3 June 2008 is relatively specific on the required conditions: the authorisation will only be provided after verification of *three major conditions*:

- *moral guarantees*, as certified by a certificate of a clean police record;
- *financial* and *professional guarantees*, like the ones that, for example, were demanded of telecommunication operators before they became electronic communication operators;[20]
- confirmation of the compliance of the envisaged systems and procedures with the technical regulations set down by the CNES.

23. Over and above these requirements, the law also uses two others found in other business sectors, but which are particularly significant here: the interests of national defence and France's compliance with its international commitments.

24. Whether or not it is referred to as a "licence," the delivered authorisation takes the shape of a unilateral administrative document, one that creates rights and brings about obligations. The creation of rights conditions its possible withdrawal, other than in the case of the sanction that will be mentioned below, and under the conditions of the now established case law of the French State Council.[21] The creation of obligations is determined by the law's Article 5, in the form of special requirements, but especially by article 6 that insists on the need for insurance or any other financial guarantee.

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[20] In this regard, the current article L33-1 of the Post and Electronic Communication Code includes comparable provisions but, it is true, while using a declaration system.

[21] Notably, the now famous *Ternon* case (EC 26 October 2001, Ternon, RFDA 2002, p.77, concl. by F. Seners and note by P. Delvolvé, 1034).

25. Without wishing to anticipate the coming developments,[22] we note that lawmakers have once again intelligently deferred to regulatory authorities for the task of stipulating the insurance provisions and, in particular, the nature of the financial guarantees; this brings about the possibility of anticipating, by order, the ability of a given operator to provide guarantees in the form of a security on its shares or assets, in the place of an insurance policy or bank surety, both of which are generally expensive.

II. THE LAW OF 3 JUNE 2008 ESTABLISHES A CONTROL SYSTEM FOR SPACE OPERATORS AND THEIR ACTIVITIES

26. The set-up of an authorisation system prior to the performance or continuation of the activities of space operators only makes sense if the competent authority has the means to exercise any control of these activities (A) and, in the event that the obligations that it includes are not respected, the power to declare sanctions as justified by the identified infractions (B).

A. The provisions for verifying the activities of space operators

27. These provisions were not simple to define. Firstly, it had to be possible to enter the relevant legislative provisions into the relatively constraining case law of the Constitutional Council[23] and secondly, it was necessary to consider the existing competencies, notably within the *Centre National d'Etudes Spatiales*, that had to be recognised and for which the intention was to provide a legislative foundation.

28. With regard to the constraints of the Constitutional Council's case law, they are now known. Indeed, the recognition of the control powers of administrative authorities entails compliance with *four conditions*, according to which an administrative control is a *supervisory measure* and not the implementation of the powers of judicial policy; the control agents cannot exercise *physical enforcement powers*, in the form of searches,

[22] In particular, *see infra* ¶ 71.

[23] *See* Law on Stock Exchanges, 97-240 DC, Constitutional Council (Jan. 19, 1988) at 28.

unless provided with authorisation to do so by a decision from the Presiding Judge of the Regional Court; the control mission can only be carried out within *premises used for professional purposes*, and during the regulatory hours; finally, the *presence of a representative of the company or institution in question* is imperative, which entails informing this person of the control mission and, should he or she be unable to be personally in attendance, he or she must be able to be represented.

29. These conditions strongly impacted the drafting of the law's Article 7, which very precisely lists the authorities having the power to verify each space operator's compliance with its legislative obligations, while notably indicating, in its paragraphs II, III, and IV, the conditions under which these authorities can exercise their prerogatives.

30. With regard to the competencies of the *Centre National d'Etudes Spatiales*, not only could they not be neglected, they had to be recognised and, insofar as possible, consecrated in legislative terms.

These competencies fall into two categories: the first involves the *safekeeping authority*, and notably the possibility granted to this public institution to interrupt a flight during the launch phase. Article 8 establishes this competency, though without identifying the authority invested with this competency and in terms which, while clearly referring to the provisions of a decree, are already very explicit with regard to the very broad prerogatives that they cover. This involves recognising, for the "administrative authority or based on the latter's delegation [to the] agents that it authorises for this purpose (...), the power, at any time, to give instructions and impose any measure that it considers necessary in the interests of the safety of persons and property and the protection of public health and of the environment."

31. From the second paragraph of the same article, we also note the following indication: "the administrative authority or the authorised agents acting with its delegation consult with the operator beforehand, except in the event of an immediate danger."

32. The second set of competencies relates to the Guyana Space Centre. They are the subject of the law's Article 21 which,

in this regard, modifies the provisions of article L331-6 of the Research Code.

33. These provisions provide the Chairman of the *Centre National d'Etudes Spatiales* or his delegatee with administrative policy powers over the installations of the Guyana Space Centre and regarding the extent of its perimeter.

34. These powers are nothing unusual. They amount to a special administrative policy power, which we also find in other public law domains, notably in the management of autonomous ports.

35. The recognition of such competencies for the CNES could not fail to bring certain difficulties to light:

- the first stemmed from a major question regarding whether or not a public institution could be attributed the prerogatives of a fully-fledged management body. The reference to the autonomous ports serves to immediately provide a positive response to this first question, particularly since the autonomous ports are unquestionably public institutions, and that their recognised competencies provide a particularly explicit precedent;

- the second related to the question of the dividing line between the competencies of the CNES Chairman and those of the Prefect of Guyana. In this latter regard, the aforesaid provisions of the law's Article 21 are quite clear, since they distinguish the general mission of safeguarding property, persons and the environment on the ground and in flight from the coordination mission, under the authority of the State's representative within Guyana, for the implementation of safety measures that justify the protection of companies located within the perimeter of the Guyana Space Centre. We therefore see that these competencies adjust themselves relative to one another in a way that can be considered satisfactory, even though the fact of the efficiency of this adjustment will have to be confirmed as part of their implementation.

36. In general terms, the control powers ascribed to the competent authority have been extended by the implementation, as part of the law of 3 June 2008, of a registration procedure for space objects that are launched. As we know, this is a

provision that was anticipated by the aforesaid agreement of 14 January 1975, as a direct extension of the convention of 29 March 1972 and an indirect extension of the Treaty of 27 January 1967.

The absence of a space law could explain that this obligation assumed by the French State pursuant to the aforesaid agreements had, perhaps, not gone unheeded until now, but had at least been satisfied within the framework of non-institutionalized procedures.

With the obligation assigned to the CNES to establish and maintain a *registry*, one might think that this international commitment will be fully applicable within the framework of internal law, provided that the French authorities provide themselves with a doctrine with regard to registration, notably by identifying the space objects that will have to be registered.

37. One might be surprised by the terse nature of the provisions of the law's Article 12. In reality, this is explained by the fact that the definition of the provisions for this registration fall more into the purview of the regulatory authorities than that of lawmakers. Hence the reference to a State Council decree for the details of the implementation of this international obligation.

B. Sanctioning the control of the activities of space operators

38. Beyond the previously described control mechanisms, it was necessary to establish a system of sanctions in case of demonstrable violations of the obligations now weighing on space operators.

This explains the fact that the law of 3 June 2008 devotes an entire chapter – chapter IV – to listing the *administrative* and *penal* sanctions.

39. As in many other activity domains, for example in the area of electronic communications,[24] the competent authority has the power to apply *administrative sanctions* consisting of a withdrawal or suspension of the provided authorisations.

[24] See, in particular, article L36-11 of the Post and Electronic Communications Code.

40. The set-up of sanctions of this type would bring up no particular difficulties, were it not that our experience of their implementation has shown their limits. Indeed, they are often either too significant or insufficiently dissuasive to form an efficient sanction system.

How can one imagine that an operator, who has received an authorisation and is therefore managing a system with satellites in outer space, could be subjected to a withdrawal or suspension of the authorisation, which would prevent this operator from carrying out its prerogatives on the system and even serve to call into question all of the agreements that led to its exploitation?

It is therefore very significant to note that neither the *Conseil Supérieur de l'Audiovisuel*, nor the *Autorité de Régulation des Communications Electroniques et des Postes* (ARCEP) has made any use of this prerogative, that has been made available to them in domains in which the withdrawal of authorisation would have immediate effects on the television viewers of a programme or on the customers of an electronic communications service.

41. On the other hand, the financial sanctions applied by the *Conseil de la Concurrence* and, to a lesser degree, the ARCEP or the CNIL (*Commission Nationale Informatique et Libertés*) have proven to be much more efficient for encouraging operators to comply with their essential obligations. It is surprising that lawmakers, and before them the government or the working group established under the aegis of the State Council, did not allow themselves to be swayed by this experience.

42. Might the provisions of paragraph 2 of Article 9 be an implicit admission of the limits of such a system, with this indication: "In case of suspension or withdrawal of the authorisation to control a launched space object, the administrative authority can order the operator to undertake, at its expense, the measures required with regard to the good conduct rules commonly accepted in order to limit the risks of damage related to this object"?

43. Over and above administrative sanctions, a mechanism for *penal sanctions* had to be set up. It is described in the law's

Article 11, with Article 10 giving the conditions for ascertaining violations.

44. The violations listed in Article 11 show a great deal of uniformity: conviction to pay a fine of € *200,000*, an amount that is believed to be sufficiently dissuasive; the violations in question can therefore be considered to fall into the category of minor offences.

45. This is a completely respectable choice, one that should be sufficient for ensuring compliance with the obligations that the law now imposes on space operators.

III. The law of 3 June 2008 organises the liability system resulting from space operations

46. This liability system is doubtlessly one of the law's main innovations. As previously indicated, its absence was patently evident as space activities were coming out of their experimental phase and the number of space operators was growing, with most of them being in the form of private companies.

47. Not only does the law establish the conditions whereby a space operator can be held liable, with the French State being required to provide its guarantee in compliance with France's international commitments, it most importantly gave details by setting down both the *extent* (A) and the *mechanism* (B) of this liability.

A. The extent of the liability resulting from space operations

48. This area had to be precisely delimited in view of the subject's importance and, even more so, the specific nature of the established liability system. In this sense, the law of 3 January 2008 conforms at a convenient moment with a new practice for laws in technical domains, one inspired by the legal systems in English-speaking countries, namely the practice of defined terms.

49. The liability system established by the law of 3 June 2008 relates primarily to third parties, understood according to the provisions of Article 1-6° as "any natural person or legal entity other than a participant in the space operation or the production of the space object(s), for which this operation is in-

tended to provide the launching or control. In particular, the space operator, its contracting parties, subcontractors and customers, as well as the co-contracting parties and sub-contracting parties of its customers are not considered to be third parties."

50. As in the liability system pertaining to public works damage, the *third party* is therefore defined in opposition to the *participants*, with the new law also establishing *two different liability systems* for these two groups.

51. As defined, the third party can only hope to be compensated for damage suffered by him/her. Here is another term that is defined in Article 1-1° that covers "any injuries suffered by persons, property and, in particular, public health or the environment, as directly caused by a space object within the framework of a space operation, with the exclusion of the consequences for users of the usage of the signal emitted by such object."

52. This definition did not bring about any difficulties, though one might regret, after the fact, that it was given a somewhat rough time by the parliamentary representation. The text of the bill, inspired by the text proposed by the working group established under the aegis of the State Council, proposed a more concise and perhaps more efficient definition: "Damage is understood to mean any injury to property or persons directly caused by a space object, with the exclusion of the consequences, for users, of the signal emitted by this object, or of the poor operation or interruption of this signal."

53. We make no criticism to the explicit reference made to public health and the environment, though this reference was implicitly contained in this definition's initial version. We regret only the wording of the exclusion, which may not correspond with the desired aim. The task was to clearly distinguish the space operation from the applications made of it, and to establish a difference between damage suffered by a third party due to the space operation *in the strictest sense*, and that suffered by this same third party, for example as the television viewer of a television station whose programmes are broadcast by satellite.

Much as it was within the scope of the law to anticipate the conditions for compensating a person who suffers as a result of a launch failure, one must also exclude any damage suffered as a result of the interruption of the signal from the satellite that the space operation had been intended to place in orbit.

As such, why not be explicit, while mentioning the users of the signal emitted by this object (space object) and the hypotheses of poor operation or usage of the signal, instead of using a circumlocution with an ambiguous meaning, notably by stating "the consequences for users of the usage of the signal emitted by this object"?

54. It was not sufficient to define the third party receiving possible compensation and without damages. It was also necessary to stipulate the *various phases* in which the damage could have been caused to third parties, by identifying the *launch phase* and that of [. . .].[25]

The former is defined in Article 1-4° as "the time period which, as part of a space operation, begins at the moment when the launch operations become irreversible and which, subject to the provisions contained, if relevant, in the authorisation provided pursuant to the present law, ends with the launcher's separation from the object intended to be placed in outer space." This definition has the merit of being perfectly explicit even as it introduces the flexibility provided by the possibility of setting out its end, in the authorisation provided to the space operator.

55. The control phase is defined as "the period of time which, as part of a space operation, begins with the launcher's separation from the object intended to be placed in outer space, and which ends with the occurrence of the first of the following elements:

- when the last de-orbiting manoeuvres and the passivation activities have been carried out;
- when the operator has lost control of the space object;
- *the space object's return to Earth or its complete disintegration in the atmosphere*."

56. Beyond these two essential steps of the space operation, the law also had to distinguish whether the damage occurred *on*

[25] Translator's note: sentence unfinished in the French.

the ground or *in the airspace*, or if caused elsewhere than in the airspace, for example in outer space. This is what Article 13 does, while deriving the consequences from the viewpoint of the liability system, to which we will return.

57. Defined in this way, the liability system established by the law of 3 June 2008 could be established in terms of its provisions.

B. The mechanism of the liability resulting from space operations

58. This mechanism revolves around the *five following elements*, which define the architecture of the liability system as a result of space operations.

59. As of Article 13, the principle is established of the space operator's liability resulting from damage that it causes to third parties as a result of the space operations that it is conducting.

60. As an extension of the provisions of the Treaty of 27 January 1967 and of the Convention of 29 March 1972, this liability is both *objective* and *exclusive*.

61. This liability depends, however, on where the damage occurs and on the operator's behaviour.

62. With regard to the *damage location*, Article 13, as previously indicated, identifies *two liability systems*:

- *absolute liability* for damage caused on the ground and in the airspace;
- *fault-based liability* for damage caused elsewhere than on the ground and in the airspace.

63. This principle of *objective* and *exclusive* liability cannot fail to be reminiscent of the system in the area of air transport, as described in Article L141.2 of the Civil Aviation Code. It only gives way when faced with proof of the victim's fault.[26]

64. With regard to the *operator's behaviour*, this same Article 13 establishes a system of liability exemption, except in case of intentional fault, for the operator who can demonstrate that

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[26] Article 13 of the law of 3 June 2008 nonetheless brings to light a legal difficulty, linked to the inadequate place given to mentioning the victim's fault.

all of the obligations established by the authorisation or licence had been met. This is a clever way of encouraging the operators in question to comply with the law, one that will come up again in the rest of these developments.

65. This principle of the operator's liability relative to third parties itself falls into the framework of a mechanism for the *activation of the State's guarantee*. This mechanism is described in Article 15 of the law of 3 June 2008 in terms that merit a special analysis.

Before doing so, it may be worthwhile to reiterate that the principle of the launching State's liability is established by international texts, and notably by the Treaty of 27 January 1967 and the Convention of 29 March 1972.

According to Article 15, its operation is a simple matter: when all of the conditions are in place, the operator whose liability is at stake "benefits from, except in case of intentional fault, the State's guarantee according to the provisions contained in the finance law."

66. The established system is therefore very explicit. The finance law sets a limit beyond which the State provides the operator with its guarantee, by paying, to the victim, the rest of the compensation that the latter may be able to claim; this guarantee applies provided that the operator is found to be totally liable, as a result of an intentional fault; this is easy enough to understand.

67. Article 15 nevertheless defines this guarantee in precise terms. It firstly relates to *operators*, according to the previously defined sense,[27] with the added guarantee that the operator in question can be either a civilian operator or a military operator. It only applies provided that this operator has been *sentenced* - which does not necessarily imply a decision from a French jurisdiction - to compensate a third party "as a result of damage caused by a space object used within the framework of an authorised operation in application of the present law;" which obviously refers back to the *space operations* for which the French State can be held liable as the launching State.

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[27] *See supra* ¶¶ 14 and 15.

The text of Article 15 further indicates "provided that the operation in question has been carried out from French territory or from that of another European Union Member State or a party to the agreement on the European Economic Area or on the basis of means or installations placed under the jurisdiction of France or of another European Union Member State or a party to the agreement on the European Economic Area."

68. Finally, it is intended to benefit the third parties as previously defined,[28] with the particularity that the third party in question does not, unlike the operator, have to meet a condition of nationality. This third party can be a French national or a foreign national.

69. Should the French State in its capacity as launching State, be immediately held liable on the basis of international agreements, the French State can then, according to the provisions of Article 14, initiate a *recursory action* against the responsible operator.

This recursory action is another way of confirming the principle of the liability of the operator behind the damage caused to a third party. Article 14 establishes a principle which is equivalent to the one contained in Article 15, in the sense that this action is only carried out if the French State can be held liable in its capacity as the launching State.

Subject to intentional fault of the operator, its amount cannot exceed the one indicated in that year's finance law, as indicated in Articles 16 and 17 of the law of 3 June 2008.

70. Finally, as an encouragement, the State's action cannot be considered in the event of "damage caused by a space object used within the framework of an operation authorised in application of the present law." Article 14 also adds the hypothesis of damage caused by "actions targeting the interests of the State."

This is an implicit reference to acts of terrorism targeting the French State, for which it would be unfair to shift the consequences to the operator if the latter has in every other way entirely complied with its obligations. This then is the principle

[28] *See supra* ¶ 49 et seq.

of *risk socialization* in the event of international acts of malicious intent, a principle that presents no particular difficulties.

The activation of the State's guarantee and also, one might imagine, in any case, the initiation of this recursory action imply a minimum degree of transparency relative to the competent authority, so that the State can itself take measures in the event of an action that could possibly benefit from either one of these provisions.

Article 18 relates to this obligation to provide information to the competent authority, and the penalty for failing to do so is dreadful, in that "the implicated person is considered to have waived any benefit of the State's guarantee."

71. This guarantee activation, just like the previously described recursory action and, in more general terms, the principle of the space operator's objective and exclusive liability, are themselves guaranteed by the previously described mechanism whereby the operator is obliged to establish financial guarantees in the form of insurance that it obtains, or of guarantees of any nature that it can secure.

On the recommendation of the Government, and beyond the Government that of the working group established under the auspices of the State Council, lawmakers were concerned that space operators should not be faced with the difficulty of obtaining coverage for the risks inherent to their activities.

In this vein, the possibility was introduced of a regulatory definition of the guarantees that the operator is able to establish in the State's favour, and which can consequently serve as an alternative to insurance.

Moreover, the differentiation of the incurred risk and the ceiling system for this risk under the previously described conditions militate in favour of insurance policies that will remain accessible under financial terms that are acceptable to space operators.

One might wonder if this encouragement mechanism might not constitute an assistance provided to French operators, and which would thus fall under the effect of the ban on State assistance according to the provisions of Article 87 of the EC Treaty. In general terms, the question can be extended to the mechanism for the activation of the State's guarantee.

72. As confirmed by the Commission, queried in this regard by the French State, this assistance is nevertheless acceptable according to the provisions of Article 87 of the aforesaid EC Treaty, and more particularly of paragraph 3, b) and c). Indeed, these provisions provide for a dispensation from the ban on State assistance provided that the "assisted" operation involves an economic sector that is of Europe-wide interest or a project encouraging European industry. No one doubts that as previously described, the provisions in question are of benefit to all European operators, irrespective of their nationality, with the French State only providing its guarantee in the event of its own recognised liability in its capacity as the launching State.

73. There remains one last and not unimportant point in the architecture of the liability system established by the law of 3 June 2008. This relates to the liability of *participants in the space operation*, according to the previously described meaning that distinguishes the participant from the third party. The participant is therefore described as "any person who has participated in the space operation or in the production of the space object" (Articles 19 and 20). As indirectly reiterated by the aforesaid provisions of the law's Article 1-6°, this primarily refers to the space operator's "co-contracting parties, subcontractors and customers," and also "co-contracting parties and subcontractors of its customers."

74. For participants, the sense of which has just been defined, the law of 3 June 2008 provides for a *double system* that serves to confirm the previous provisions:

- Firstly, a *guarantee pact* is established, which allows the operation of the guarantee mechanisms anticipated by the law, whether this involves insurance or financial guarantees established by the operator or the State's guarantee under the previously described conditions. This guarantee pact operates in the following manner: "the liability of one of the persons having participated in the space operation or in the production of the space object that is the cause of the damage cannot be sought by any other of these persons." Article 19 stipulates: "except in case of intentional fault," which may be surprising. This clarification is in reality explained with reference to the decisions of the Constitutional Council, which reserves its hypotheses for the waiver to recourse in the name of the principle of civil liability established by article 1382, and of the republican principle of equality.[29] It would be difficult to understand that we could accept, without restrictions, a mechanism for setting aside liability and for a waiver of recourse, by reserving the hypothesis of intentional fault; the provisions of the law's Article 19 remain in compliance with the case law of the Constitutional Council, in particular its decision handed down on 22 October 1982 regarding the Auroux laws.

- Moreover, the law gives a legal basis to the *non-guarantee clauses* contained in a great number of contracts that are signed when setting up a space operation. These non-guarantee clauses traditionally elicited questions as to their validity, as they are directly contrary to the provisions of Article 1643 of the Civil Code.[30] By giving them a legal basis, they are put outside of the scope of cancellation decisions.

75. Relative to the same point, it is not without merit to bring up the interesting question of the compatibility of the recourse waiver clause established in Article 19, with the provisions of Article 1386-15 of the Civil Code. These provisions stem from the texts for the transposition into French law of the famous directive relating to defective products, dated 25 July 1985.

We recall that the provisions of this latter article stipulate that "clauses intended to set aside or limit liability as a result of defective products are forbidden and considered not to have been written." It nevertheless establishes a "restriction for damage caused to assets that are not used by the victim primarily for the latter's private usage or consumption." Subject to a diverging interpretation by the jurisdictions, it would seem that the hypotheses covered by Articles 19 and 20 would primarily relate to relations *between professionals*, as all economic opera-

[29] *See* Law 82-144 DC, Constitutional Council (Oct. 22, 1982) at 189.

[30] According to article 1643 of the Civil Code, the seller "is bound by the guarantee against hidden defects, even if unaware thereof, unless, in this case, it had stipulated that it would not be bound by any guarantee."

tors have an industrial or commercial activity and that there was fairly little chance that they would fall into the definition of *private consumption* stipulated by the provisions of Article 1386-15 of the Civil Code.

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76. As we see, the law of 3 June 2008 describes a consistent legal edifice that provides an opportunity for a basis for the definition of a policy for space activities. The report published at the end of the works of the working group established under the auspices of the State Council carries a more limiting title, as it expressly targets a “legal” policy for space activities. This is explained by the fact that the mission that had been entrusted to it pertained primarily to the preparation of a text likely to garner the interest of the Government and of the Parliament.

77. This text having been adopted, the Government and the French Parliament must now get down to the definition of a policy, in the broad sense of the word.

78. Time will tell if they have given themselves both the objective and the means, even if the new orientations given to France’s defence policy certainly seem to rely on a more significant role given to intelligence and, consequently, to the space dimension of defence, at the same time as the multiplication of the applications of space industries is confirming that satellite-based communications are established within the French economic life, to such a degree as to constitute one of the major elements of its international economic specialisation.

79. It remains that the approach must be emphasized, and that it is based on the definition of a legal framework. It is unusual, but can be viewed as encouraging. It is, if we finally provide the law and its legal disciplines with a strategic dimension, instead of the purely management activities to which we still too often reduce them.

On this good old planet, and in the space that surrounds it!

BIBLIOGRAPHY

AVIATION AND SPACE LAW: RELEVANT PUBLICATIONS

P.J. Blount[*]

AVIATION

Legislation and Regulations

Australia

Aviation Legislation Amendment (2008 Measures No. 2) Bill 2009 No. 26, 2009 (Austl.).

Civil Aviation Amendment Bill 2009 No. 19, 2009 (Austl.).

European Union

Commission Decision of 3 March 2009 on the Community position as regards Decision No 1/2008 of the ECAA Joint Committee set up under the Multilateral Agreement between the European Community and its Member States, Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the former Yugoslav Republic of Macedonia, Iceland, Montenegro, Norway, Romania, Serbia and the United Nations Interim Administration Mission in Kosovo on the establishment of a European Common

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Aviation Area, amending Annex I to the Agreement (2009/243/EC) 2009 J.O. (L 72) 6.

Commission regulation (EC) No 1056/2008 of 27 October 2008 amending Regulation (EC) No 2042/2003 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks, 2008 J.O. (L 283) 5.

Commission Regulation (EC) No 1057/2008 of 27 October 2008 amending Appendix II of Annex to Regulation (EC) No 1702/2003 concerning the Airworthiness Review Certificate (EASA Form 15a), 2008 J.O. (L 283) 30.

Commission Regulation (EC) No 1131/2008 of 14 November 2008 amending Regulation (EC) No 474/2006 establishing the Community list of air carriers which are subject to an operating ban within the Community, 2008 J.O. (L 306) 47.

Council Decision of 24 July 2008 on the signing and provisional application of a Memorandum of Cooperation between the International Civil Aviation Organisation and the European Community regarding security audits/inspections and related matters (2009/97/EC) 2009 J.O. (L 36) 18.

Council Decision of 27 November 2008 on the signing of the Agreement between the European Community and the Republic of Armenia on certain aspects of air services, 2009 J.O. (L 50) 21.

Cypriot national procedure for the allocation of limited air traffic rights (2009/C 56/08) 2009 J.O. (C 56) 37.

Decision No 1/2008 of the Joint Community/Switzerland Air Transport Committee Set Up Under the Agreement Between the European Community and the Swiss Confederation on Air Transport of 16 December 2008 replacing the Annex to the Agreement between the European Community and the Swiss Confederation on Air Transport (2009/115/EC) 2009 J.O. (L 40) 38.

European Council Decision of 7 April 2008 on the signing and provisional application of the Agreement between the European Community and the Government of Nepal on certain aspects of air services (2009/117/EC) 2009 J.O. (L 41) 3.

European Parliament legislative resolution of 18 November 2008 on the proposal for a Council regulation amending Council

Regulation (EC) No 219/2007 on the establishment of a joint undertaking to develop the new generation European air traffic management system (SESAR) (COM(2008)0483 – C6-0305/2008 – 2008/0159(CNS)), EUR. PARL DOC. P6_TA(2008)0529 (2008).

European Parliament legislative resolution of 16 December 2008 on the proposal for a Council decision on the conclusion of the Agreement between the European Community and the Republic of India on certain aspects of air services (COM(2008)0347 – C6-0342/2008 – 2008/0121(CNS)), EUR. PARL DOC. P6_TA(2008)0587 (2008).

European Parliament legislative resolution of 13 January 2009 on the proposal for a Council decision on the conclusion of an Agreement between the European Community and the United States of America on cooperation in the regulation of civil aviation safety (10972/2007 – COM(2007)0325 – C6-0275/2008 – 2007/0111(CNS)), EUR. PARL DOC. P6_TA(2009)0001 (2009).

Regulation (EC) No 1008/2008 of The European Parliament and of The Council of 24 September 2008 on common rules for the operation of air services in the Community (Recast), 2008 J.O. (L 293) 3.

United Kingdom

The Air Navigation (Jersey) Order 2008, S.I. 2008/2562 (U.K. 2008).

The Civil Aviation (Overseas Territories) (Gibraltar) (Revocations) Order 2008, S.I. 2008/3119 (U.K. 2008).

The Air Navigation (Guernsey) (Revocation) Order 2008, S.I. 2008/3121 (U.K. 2008).

The Air Navigation (Overseas Territories) (Amendment) Order 2008, S.I. 2008/3125 (U.K. 2008).

The Civil Aviation (Overseas Territories) (Gibraltar) (Revocations) (No. 2) Order 2008, S.I. 2008/3120 (U.K. 2008).

The Air Navigation (Environmental Standards For Non-EASA Aircraft) Order 2008, S.I. 2008/3133 (U.K. 2008).

The Air Navigation (Restriction of Flying) (Nuclear Installations) (Amendment) Regulations 2008, S.I. 2008/3169 (U.K. 2008).

The Aerodromes (Designation) (Chargeable Air Services) (Revocation) Order 2009, S.I. 2009/18 (U.K. 2009).

The Operation of Air Services in the Community Regulations 2009, 2009/41 (U.K. 2009).

Excise, The Air Passenger Duty (Rate) (Qualifying Territories) (Variation of Description) Order 2009, S.I. 2009/193 (U.K. 2009).

Cases

European Union

Commission Decision of 11 March 2008 on a State aid scheme implemented by Italy for the aeronautical industry (C 61/03 (ex NN 42/01)) (2008/806/EC), 2008 J.O. (L 284) 1.

Judgment of the Court (Second Chamber) of 16 October 2008 — Commission of the European Communities v Kingdom of Spain (Case C-136/07) (1) (Failure of a Member State to fulfil obligations — Directives 89/48/EEC and 92/51/EEC — Recognition of diplomas and professional education and training — Profession of air traffic controller) (2008/C 313/07), 2008 J.O. (C 313) 5.

United States

Town of Marshfield v. FAA, 552 F.3d 1 (1st Cir. 2008).

NRDC v. FAA, No. 06-5267-ag, 2009 U.S. App. LEXIS 9425 (2d Cir. 2009).

Breaux v. Halliburton Energy Servs., No. 07-30964, 2009 U.S. App. LEXIS 4310 (5th Cir. 2009).

Menard v. FAA, 548 F.3d 353 (5th Cir. 2008).

Bowling Green & Warren County Airport Bd. v. Martin Land Dev. Co., 561 F.3d 556 (6th Cir. 2009)

Collins v. United States, No. 08-1334, 2009 U.S. App. LEXIS 9437 (7th Cir. 2009).

United Air Lines, Inc. v. Air Line Pilots Ass'n, Int'l, No. 08-4157, 2009 U.S. App. LEXIS 5142 (7th Cir. 2009).

United Air Lines, Inc. v. Reg'l Airports Improvement Corp., Nos. 08-2736, 08-2751, 08-2752, 08-2824 & 08-2905, 2009 U.S. App. LEXIS 9648 (7th Cir. 2009).

Data Mfg. v. UPS, 557 F.3d 849 (8^{th} Cir. 2009).

Andrzejewski v. FAA, 548 F.3d 1257 (9^{th} Cir. 2008).

Martin v. Midwest Express Holdings, Inc., 555 F.3d 806 (9^{th} Cir. 2009).

Moore-Thomas v. Alaska Airlines, Inc., 553 F.3d 1241 (9^{th} Cir.).

United States v. Parker, 553 F.3d 1309 (10^{th} Cir.).

Adams v. FAA, 550 F.3d 1174 (D.C. Cir. 2008).

Ass'n of Flight Attendants-CWA v. United States DOT, No. 08-1165, 2009 U.S. App. LEXIS 9420 (D.C. Cir. 2009).

Gorman v. NTSB, 558 F.3d 580 (D.C. Cir. 2009).

Southwest Airlines Co. v. Transp. Sec. Admin., 554 F.3d 1065 (D.C. Cir. 2009).

St. John's United Church of Christ v. FAA, 550 F.3d 1168 (D.C. Cir. 2008).

Sunworld Int'l Airlines, Inc. v. NTSB, No. 08-1137, 2008 U.S. App. LEXIS 26300 (D.C. Cir. 2008).

Am. Airlines, Inc. v. United States, 551 F.3d 1294 (Fed. Cir. 2009).

Aycock Eng'g, Inc. v. Airflite, Inc., 560 F.3d 1350 (Fed. Cir. 2009).

Addington v. US Airline Pilots Ass'n, 588 F. Supp. 2d 1051 (D. Ariz. 2008).

Addington v. US Airline Pilots Ass'n, No. CV 08-1633-PHX-NVW (consolidated), 2009 U.S. Dist. LEXIS 26744 (D. Ariz. 2009).

Clark v. Native Am. Air Ambulance Inc., No. 06-CV-2920-PHX-PGR, 2009 U.S. Dist. LEXIS 25366 (D. Ariz. 2009).

Ray v. Am. Airlines, Inc., No. 08-5025, 2009 U.S. Dist. LEXIS 28182 (W.D. Ark. 2009).

Greenstein v. Peters, No. CV 08-6104 PSG (Ex), 2009 U.S. Dist. LEXIS 22904 (C.D. Cal. 2009).

Hornsby v. Lufthansa German Airlines, 593 F. Supp. 2d 1132 (C.D. Cal. 2009).

Webb v. Estate of Cleary, No. EDCV-08-565-SGL (AJWx), 2008 U.S. Dist. LEXIS 105231 (C.D. Cal. 2008).

Getz v. Boeing Co., No. C 07-06396 CW, 2009 U.S. Dist. LEXIS 18815 (N.D. Cal. 2009).

Oilund v. United Airlines, No. C 08-4016 TEH, 2009 U.S. Dist. LEXIS 5439 (N.D. Cal. 2009).

Blackwell v. Skywest Airlines, Inc., No. 06cv0307 DMS (AJB), 2008 U.S. Dist. LEXIS 97955 (S.D. Cal. 2008).

Melgares v. Sikorsky Aircraft Corp., Civil Action No. 08-cv-0995 (JCH) consolidated with 08-cv-1002(JCH),08-cv-1014(JCH), 2009 U.S. Dist. LEXIS 21881 (D. Conn. 2009).

Ward v. State Dep't of Pub. Safety, No. 3:06CV01936 (PCD), 2009 U.S. Dist. LEXIS 3756 (D. Conn. 2009).

Burkhart v. Chertoff, No. 2:06-cv-690-FtM-99DNF, 2009 U.S. Dist. LEXIS 72 (M.D. Fla. 2009).

Fla. Clean Water Network, Inc. v. Grosskruger, 587 F. Supp. 2d 1236 (M.D. Fla. 2008).

Larsen v. Airtran Airways, Inc., No. 8:07-CV-00442-T-17-TBM, 2009 U.S. Dist. LEXIS 33515 (M.D. Fla. 2009).

Eli Lilly & Co. v. Air Express Int'l USA, Inc., No. 06-23048-CV-MOORE, 2009 U.S. Dist. LEXIS 18228 (S.D. Fla. 2009).

Konop v. Hawaiian Airlines, Inc. (In re Hawaiian Airlines, Inc.), No. 08-00538 HG-KSC, 2009 U.S. Dist. LEXIS 29727 (D. Haw. 2009).

Konop v. Hawaiian Airlines, Inc., No. 09-00012 HG-LEK, 2009 U.S. Dist. LEXIS 39026 (D. Haw. 2009).

Aviation Fin. Group, LLC v. Duc Hous. Ptnrs, Inc., No. 1:08-CV-535, 2009 U.S. Dist. LEXIS 38802 (D. Idaho 2009).

Schoeffler-Miller v. Northwest Airlines, Inc., No. 08-cv-4012, 2008 U.S. Dist. LEXIS 93851 (C.D. Ill 2008).

Valley Air Serv. v. Southaire, Inc., No. 06 C 782, 2009 U.S. Dist. LEXIS 32709 (E.D. Ill. 2009).

Meyer v. United Airlines, Inc., No. 08 C 0599, 2009 U.S. Dist. LEXIS 11114 (N. Ill. 2009).

Cunningham Charter Corp. v. Learjet, Inc., No. 07-cv-233-DRH, 2009 U.S. Dist. LEXIS 35184 (S.D. Ill. 2009).

Dodson Aviation, Inc. v. HLMP Aviation Corp., No. 08-4102-EFM, 2009 U.S. Dist. LEXIS 37364 (D. Kan. 2009).

In re Cessna 208 Series Aircraft Prods. Liab. Litig., No. 05-md-1721-KHV, 2009 U.S. Dist. LEXIS 30767 (D. Kan. 2009).

In re Cessna 208 Series Aircraft Prods. Liab. Litig., No. 05-md-1721-KHV, 2009 U.S. Dist. LEXIS 37901 (D. Kan. 2009).

Crouch v. Honeywell Int'l, Inc., No. 3:07CV-638-S, 2009 U.S. Dist. LEXIS 24041 (W.D. Ken. 2009).

Roberts v. Delta Air Lines, Inc., No. 07-cv-12154-DPW, 2008 U.S. Dist. LEXIS 102674 (D. Mass. 2009).

Air Line Pilots Ass'n v. Pinnacle Airlines, Inc., No. 07-15380, 2009 U.S. Dist. LEXIS 15118 (E.D. Mich. 2009).

Canada-Neal v. Delta Airlines, Inc., No. 1:08-cv-232, 2009 U.S. Dist. LEXIS 31662 (W.D. Mich. 2009).

Bremer Bank v. John Hancock Life Ins. Co., Civil No. 06-1534 ADM/JSM, 2009 U.S. Dist. LEXIS 21055 (D. Minn. 2009).

Herrmann v. Expressjet Airlines, Inc., Civ. No. 08-977 (RHK/JJK), 2009 U.S. Dist. LEXIS 37975 (D. Minn. 2009).

Sturge v. Northwest Airlines, Inc., No. 05-1665(DSD/SRN), 2009 U.S. Dist. LEXIS 21050 (D. Minn. 2009).

Sturge v. Northwest Airlines, Inc., No. 07-499 (JRT/JJG), 2009 U.S. Dist. LEXIS 26422 (D. Minn. 2009).

Jones v. USA 3000 Airlines, No. 4:08-CV-1855 (CEJ), 2009 U.S. Dist. LEXIS 9049 (E.D. Mo. 2009).

Schwartz v. Metro Aviation, Inc., No. CV 08-32-M-JCL, 2009 U.S. Dist. LEXIS 9448 (D. Mont. 2009).

Hutchinson v. British Airways PLC, No. 08-cv-2781(NGG), 2009 U.S. Dist. LEXIS 28881 (E.D.N.Y. 2009).

Okoi v. El Al Isr. Airlines, Civil Action No. 05-5370 (DRH)(WDW), 2009 U.S. Dist. LEXIS 9610 (E.D.N.Y. 2009).

Siotkas v. Labone, Inc., 594 F. Supp. 2d 259 (E.D.N.Y. 2009).

Vanbrocklen v. United States, No. 1:08-CV-312 (TJM/RFT), 2009 U.S. Dist. LEXIS 24854 (N.D.N.Y. 2009).

Atlasjet Uluslararasi Havacilik A.S. v. EADS Aeroframe Servs., LLC, No. 07 Civ. 212 (RJS), 2009 U.S. Dist. LEXIS 17077 (S.D.N.Y. 2009).

In re September 11th Litig., 590 F. Supp. 2d 535 (S.D.N.Y. 2008).

In re September 11 Litig., 594 F. Supp. 2d 374 (S.D.N.Y. 2009).

In re September 11 Litig., 600 F. Supp. 2d 549 (S.D.N.Y. 2009).

In re September 11 Litig., No. 21 MC 101 (AKH), 2009 U.S. Dist. LEXIS 37189 (S.D. N.Y. 2009).

Khan v. Am. Airlines, Inc., No. 08 CV 5246 (NRB), 2008 U.S. Dist. LEXIS 99835 (S.D.N.Y. 2008).

Ovesen v. Mitsubishi Heavy Indus. of Am.,Inc., No. 04 Civ. 2849 (JGK)(FM), 2009 U.S. Dist. LEXIS 9762 (S.D.N.Y. 2009).

Tradewinds Airlines, Inc. v. Soros, No. 08 Civ. 5901 (JFK), 2009 U.S. Dist. LEXIS 13867 (S.D.N.Y. 2009).

News & Observer Publ. Co. v. Raleigh-Durham Airport Auth., 588 F. Supp. 2d 653 (E.D.N.C. 2008).

Waters v. NMC-Wollard, Inc., No. 06-0032, 2009 U.S. Dist. LEXIS 617 (E.D. Penn. 2009).

Perez-Ramos v. Spirit Airlines, Inc., Civil No. 08-1574(SEC), 2009 U.S. Dist. LEXIS 23911 (D.P.R. 2009).

King Aero. Commer. Corp., Inc. v. Al-Anwa Aviation, Inc., Civil Action No. 3:08-CV-0999-L, 2009 U.S. Dist. LEXIS 24430 (N.D. Tex. 2009).

Wilson v. Hawker Beechcraft Servs., No . Civil Action H-08-1652, 2008 U.S. Dist. LEXIS 103691 (S.D. Tex. 2008).

AVCO Corp. v. North, No. 2:08-cv-27, 2009 U.S. Dist. LEXIS 18778 (D. Vt. 2009).

Nathaniel v. Am. Airlines, No. 2007/0033, 2008 U.S. Dist. LEXIS 95336 (D.V.I. 2009).

Jackson v. United Airlines, Inc., No. 3:08CV182, 2009 U.S. Dist. LEXIS 34252 (E.D. Va. 2009).

Kelley v. United States, No. 1:08-cv-31 (AJT/TRJ), 2009 U.S. Dist. LEXIS 23659 (E.D. Va. 2009).

Signature Flight Support Corp. v. Landow Aviation Ltd. P'ship, No. 1:08cv955 (JCC), 2009 U.S. Dist. LEXIS 2541 (E.D. Va. 2009).

Alaska Airlines, Inc. v. Carey, No. C07-5711RBL, 2009 U.S. Dist. LEXIS 30577 (W.D. Wash. 2009).

Ulrich v. Alaska Airlines, Inc., No. C07-1215RSM, 2009 U.S. Dist. LEXIS 10104 (W.D. Wash. 2009).

Qayyum v. US Airways, Inc., No. 3:08-0996, 2008 U.S. Dist. LEXIS 92365 (S.D.W.V. 2008).

Mountan v. Chautauqua Airlines, Inc., No. 06C1026, 2009 U.S. Dist. LEXIS 23895 (E.D. Wis. 2009).

In re Aloha Airlines, Inc., No. 08-00337, 2008 Bankr. LEXIS 3971 (Bankr. D. Haw. 2008).

San Antonio Aerospace, L.P. v. ATA Airlines, Inc. (In re ATA Airlines, Inc.), 51 Bankr. Ct. Dec. 108 (Bankr. S.D. Ind. (2009).

Guimei v. General Electric Co., 91 Cal. Rptr. 3d 178 (Cal. Ct. App. 2009).

Auerbach v. Los Angeles County Assessment Appeals Bd. No. 2, 85 Cal. Rptr. 3d 105 (Cal. Ct. App. 2008).

Auerbach v. Los Angeles County Assessment Appeals Bd. No. 2, 85 Cal. Rptr. 3d 118 (Cal. Ct. App. 2008).

Griswold Airport, Inc. v. Town of Madison, 961 A.2d 338 (Conn. 2008).

Airport Auth. v. City of St. Marys, No. A09A0786., 2009 Ga. App. LEXIS 494 (Ga. Ct. App. 2009).

Airtran Airways, Inc. v. Fortney, No. 2008-CA-001223-WC, 2009 Ky. App. LEXIS 42 (Ken. Ct. App. 2009).

Fisher & Co. v. Dep't of Treasury, 282 Mich. App. 207 (Mich. Ct. App. 2009).

Great Southern Bank v. Dir. of Revenue, 269 S.W.3d 22 (Mo. 2008).

Dallas Airmotive, Inc. v. FlightSafety Int'l, Inc., 277 S.W.3d 696 (Mo. Ct. App. 2008).

A/K Serv., LLC v. Harris County Appraisal Dist., No. 01-08-00169-CV, 2008 Tex. App. LEXIS 8566 (Tex. App. 2008).

ICAN Enter. v. Williamson County Appraisal Dist., No. 03-06-00594-CV, 2009 Tex. App. LEXIS 2596 (Tex.App. 2009).

Frequent Flyer Depot, Inc. v. Am. Airlines, Inc., No. 2-08-386-CV, 2009 Tex. App. LEXIS 1332 (Tex. App. 2009).

Nogle & Black Aviation, Inc. v. Faveretto, No. 14-08-00272-CV, 2009 Tex. App. LEXIS 2406 (Tex. App. 2009).

Specialities, L.L.C. v. Wilmington Air Ventures IV, Inc., No. 02-08-062-CV, 2008 Tex. App. LEXIS 8707 (Tex. App. 2008).

Starflight 50, L.L.C. v. Harris County Appraisal Dist., No. 01-08-00234-CV, 2009 Tex. App. LEXIS 2097 (Tex. Ct. App. 2009).

Va. Highlands Airport Auth. v. Singleton Auto Parts, Inc., 670 S.E.2d 734 (Va. 2009).

Burton v. Twin Commander Aircraft, LLC, 148 Wn. App. 606 (Wash. Ct. App. 2009).

Spokane Airports v. RMA, Inc., No. 26538-2-III, 2009 Wash. App. LEXIS 984 (Wash. Ct. App. 2009).

U.S. Administrative Decisions and Executive Orders

Trident World Systems, Inc., B-400901 (Gov't Accountability Office, Feb. 23, 2009).

Exec. Order No. 13497, Transformation of the National Air Transportation System, 73 Fed. Reg. 70241 (2008.)

Articles

Ruwantissa Abeyratne, *The ICAO Conference on the Economics of Airports and Air Navigation Services,* 34 AIR & SPACE L. 39 (2009).

Usha Balasubramaniam, *Air Passenger Health and Consumer Protection*, 73 J. AIR L. & COM. 675 (2008).

Joachim Bentzien, *Der Überflug als Rechtsproblem / Problems Relating to the "First Freedom" of the Air / Problèmes relatifs à la "remière liberté"de l'air*, 2008 ZLW 508 (2008).

McKay Cunningham, *The Montreal Convention: Can Passengers Finally Recover for Mental Injuries?*, 41 VAND. J. TRANSNAT'L L. 1043 (2008).

Jessica Finan, comment, *A New Flight in the International Aviation Industry: the Implications of the United States-European Union Open Skies Agreement*, 17 TUL. J. INT'L & COMP. L. 225 (2008).

Joseph Z. Fleming, *The Application of U.S. Labor and Employment Laws to Airlines: Regulating the Global Labor and Employment Affairs of Airlines in a World That is Flat,* 8 ISSUES IN AVIATION L. & POL'Y_ (2009).

Jonathan R. Friedman & Matthew S. Knoop, *A Wolf in Wolf's Clothing—Other Incident Evidence in Aviation Litigation*, 73 J. AIR L. & COM. 441 (2008).

John A. Gallagher, comment, *Civil Rights - First Circuit Incorrectly Adopts Arbitrary-or-Capricious Standard for Reviewing Airliner's Decision to Remove Passengers - Cerqueira v. American Airlines, Inc., 520 F.3d 1 (1st Cir. 2008), cert. denied, 129 S. Ct. 111 (2008)*, 42 SUFFOLK U. L. REV. 303 (2009).

Philip G. Gayle, *An Empirical Analysis of the Competitive Effects of the Delta/Continental/Northwest Code-Share Alliance*, 51 J.L. & ECON. 743 (2008).

Markus Geisler & Marius Boewe, *Zu neuen Entwicklungen im Bereich der Slot-Vergabe. Die Mitteilung der Europäischen Kommission zur Auslegung relevanter Rechtsvorschriften/ New Developments Relating to Slot Allocation in Europe/ Nouveaux développements relatifs aux allocations des slots en Europe,* 2008 ZLW 501 (2008).

Elmar Giemulla, *Zum Einsatz von Tragschraubern durch die Polizei / The Use of Gyrocopters for Police Operations / Utilisation des gyrocopters pour opérations policières*, 2009 ZLW 34 (2009).

Geert Goeteyn, *EC Aviation Scene Major Developments July 2008-November 2008*, 34 AIR & SPACE L. 105 (2009).

Brian F. Havel, Commentary, *In Praise of Law's Cosmos: Reflections on the Entreprenurial Spirit in Aviation Law and Policy,* 8 ISSUES IN AVIATION L. & POL'Y_ (2009).

Brian F. Havel and Niels van Antwerpen, *The Dutch Ticket Tax and Article 15 of the Chicago Convention*, 34 AIR & SPACE L. 141 (2009).

Huang Jiefang, *Aviation Safety, ICAO and Obligations Erga Omnes*, 8 CHINESE J. OF INT'L L. 63 (2009).

Norbert Kämper, *Das selbstständige Genehmigungsverfahren für Flugplätze (Teil I)/ Independent Authorisation Procedure for Aerodromes in Germany (Part I)/ Procédure indépendante pour l´autorisation des aérodromes en Allemagne (1ère partie)*, 2008 ZLW 487 (2008).

Norbert Kämper, *Das selbständige Genehmigungsverfahren für Flugplätze, Teil II / Independent Authorisation Procedure for Aerodromes in Germany (Part II) / Procédure indépendante pour l'autorisation des aérodromes en Allemagne (2ème partie),* 2009 ZLW 16 (2009).

Lawrence J. Kelly, *Is that "Whoosh" You Hear a New Whisper-jet Whisking Across U.S. Skies, or the Perotvian "Sucking-sound" of Jobs Leaving the Country? A Review of the Impact of US-EU Open Skies Agreement Negotiations on the Leverage, Lifestyle, and Legal Standing of U.S. Aviation Labor*, 14 LAW & BUS. REV. AM. 699-736 (2008).

Kostis Kostopoulos, *Commitment Decisions: The New Kind of Settlement in European Competition Law. Application in Air Transport,* 34 AIR & SPACE L. 13 (2009).

Johnson Kuncheria, comment, *The Department of Homeland Security Proposes an Advance Passenger Information Requirement for Private Aircraft: Paranoia or Reasonable Security?*, 73 J. AIR L. & COM. 513 (2008).

William Lahey & Patricia Heilbron, *Aviation Fueling at Large Airports: Negotiating Workable Agreements Between Airlines and Airport Proprietors*, 35 Transp. L.J. 245 (2009).

Iris Lienhart, *Luftsicherheit im europäischen Kontext: Die Revision der Verordnung (EG) Nr. 2320/2002 / Aviation Security in European Context: the Revision of Regulation (EC) No. 2320/2002 / Securité aérienne en contexte européen: la révision de la régulation (CE) No. 2320/2002*, 2009 ZLW 1 (2009).

Tim Marland, *Reports on Montreal Convention 1999 Court Decisions Court of Appeal Does Not Put a Foot Wrong*, 34 AIR & SPACE L. 135 (2009).

Anna Masutti, *Proposals for the Regulation of Unmanned Air Vehicle Use in Common Airspace*, 34 AIR & SPACE L. 1 (2009).

Pablo M. J. Mendes de Leon, *A Tour d'Horizon of Contemporary Issues in Air and Space Law*, 8 ISSUES IN AVIATION L. & POL'Y_ (2009).

Michael Milde, *Liability for Damage Caused by Aircraft on the Surface: Past and Current Efforts to Unify the Law/ Zur Haftung für Schäden, die Dritten auf der Erde durch Luftfahrzeuge zugefügt werden: Arbeiten zur Rechtsvereinheitlichung/ Responsabilité pour dommages causés aux tiers à la surface par des aéronefs: travaux concernant l'unification du droit*, 2008 ZLW 532 (2008).

Michael Milde, *"Rendition Flights" and International Air Law*, 2008 ZLW 477 (2008).

Tobias W. Mock, *The TSA's New X-Ray Vision: The Fourth Amendment Implications of "Body-Scan" Searches at Domestic Airport Security Checkpoints*, 49 SANTA CLARA L. REV. 213 (2008).

Kevin W. Murphy, *Closing Argument: Addressing Damages in Aviation Wrongful Death Cases*, 73 J. AIR L. & COM. 463 (2008).

Jeff Orkin, comment, *Fair Treatment for Experienced Pilots Act—All Good Things Really Do Come to an End!*, 73 J. AIR L. & COM. 579 (2008).

Bimal Patel, *A Flight Plan Towards Financial Stability—The History and Future of Foreign Ownership Restrictions in the United States Aviation Industry*, 73 J. AIR L. & COM. 487 (2008).

Vincent J. Power, *Ryanair v. European Commission: The European Court of First Instance's Judgment on Alleged State Aid at Charleroi Airport*, 8 ISSUES IN AVIATION L. & POL'Y_ (2009).

David E. Rapoport & Michael L. Teich, *The Pre-Abdullah Consensus that Federal Law Does Not Preempt the Field of Aviation Safety in Tort Cases Should Remain the Law*, 8 ISSUES IN AVIATION L. & POL'Y_ (2009).

D. Richard Rasmussen, comment, *Is international travel per se suspicion of terrorism? The dispute between the United States and European Union over passenger name record data transfers*, 26 WIS. INT'L L.J. 551-590 (2008).

Daniel B. Reagan, note, *Putting International Aviation Into the European Union Emissions Trading Scheme: Can Europe Do It Flying Solo?* 35 B.C. ENVTL. AFF. L. REV. 349 (2008).

Onno Rijsdijk, A Particular Aircraft Accident Litigation Scenario, 34 AIR & SPACE L. 57 (2009).

Pierre Schlag, *Spam Jurisprudence, Air Law, and the Rank Anxiety of Nothing Happening (A Report on the State of the Art)*, 97 GEO. L.J. 803 (2009).

Erin Shea, comment, *Analysis of the Proposed Hub Carrier "Slot" Preference at Chicago O'Hare*, 73 J. AIR L. & COM. 611 (2008).

Will S. Skinner, *The Sophisticated Pilot: A New Line of Defense in the Field of General Aviation*, 73 J. AIR L. & COM. 527 (2008).

Julie Solomon, comment, *Does the TSA Have Stage Fright? Then Why Are They Picturing You Naked?*, 73 J. AIR L. & COM. 643 (2008).

Martin Staniland, *Air Transport and the EU's Emissions Trading Scheme: Issues and Arguments*, 8 ISSUES IN AVIATION L. & POL'Y_ (2009).

Mark C. Stephens, note and comment, *Losing Lift and Creating Drag! The Effect of National Mediation Board Execution and Railway Labor Act Court Decisions on the Collective Bargaining Process in the Airline Industry: A Union Perspective*, 15 TEX. WESLEYAN L. REV. 141 (2008).

Ulrich Steppler & Christian Kusulis, *Ruling on Promotion of Air Fares and Price Transparency under German Law by the Hamburg Appellate Court*, 34 AIR & SPACE L. 49 (2009).

Stefan Talmon, *The Recognition of the Chinese Government and the Convention on International Civil Aviation*, 8 CHINESE J. OF INT'L L. 135 (2009).

Carlos Grau Tanner, *Agenda for Freedom for International Air Transport New Proposals to Break the Foreign Ownership Deadlock in the Airline Industry*, 34 AIR & SPACE L. 127 (2009).

Robbert van der Vliet, *Europe's Take on Interlining – I: Multilateral Interlining and EU Competition Law*, 8 ISSUES IN AVIATION L. & POL'Y_ (2009).

Robbert van der Vliet, *Report on the Twentieth Annual EALA Conference, Prague 7 November 2008*, 34 AIR & SPACE L. 35 (2009).

Christian Westra, *The April 2007 U.S.–EU "Open Skies" Agreement: A Dream of Liberalization Deferred*, 32 B.C. INT'L & COMP. L. REV. 161 (2009).

Books and Reports

RUWANTISSA ABEYRATNE, AVIATION AND THE ENVIRONMENT (2009).

AIR AND SPACE LAW: SELECTED DOCUMENTS (Willem-Jan van der Wolf & Claudia Tofan eds.) (2008).

COMMISSION OF THE EUROPEAN COMMUNITIES, REPORT FROM THE COMMISSION ON FINANCING AVIATION SECURITY (2009).

BART ELIAS, FEDERAL AVIATION ADMINISTRATION REAUTHORIZATION: AN OVERVIEW OF SELECTED PROVISIONS IN PROPOSED LEGISLATION CONSIDERED BY THE 110TH CONGRESS, Congressional Research Service (2009).

BART ELIAS, NATIONAL AVIATION SECURITY POLICY, STRATEGY, AND MODE-SPECIFIC PLANS: BACKGROUND AND CONSIDERATIONS FOR CONGRESS, Congressional Research Service (2009).

JOHN W. FISCHER, WILLIAM J. MALLET, ROBERT S. KIRK, & JOHN FRITTELLI, TRANSPORTATION AND TRANSPORTATION SECURITY RELATED PROVISIONS OF HOUSE AND SENATE STIMULUS LEGISLATION (H.R. 1), Congressional Research Service (2009).

MARKUS GEISLER & MARIUS BOEWE, THE GERMAN CIVIL AVIATION ACT (2009).

ELMAR GIEMULLA & LUDWIG WEBER, HANDBOOK ON AVIATION LAW (2009).

GOV'T ACCOUNTABILITY OFFICE, AVIATION AND THE ENVIRONMENT: INITIAL VOLUNTARY AIRPORT LOW EMISSIONS PROGRAM PROJECTS REDUCE EMISSIONS, AND FAA PLANS TO ASSESS THE PROGRAM'S OVERALL PERFORMANCE AS PARTICIPATION INCREASES, GAO-09-37 (2008).

GOV'T ACCOUNTABILITY OFFICE, AVIATION SAFETY: NASA'S NATIONAL AVIATION OPERATIONS MONITORING SERVICE PROJECT WAS DESIGNED APPROPRIATELY, BUT SAMPLING AND OTHER ISSUES COMPLICATE DATA ANALYSIS, GAO-09-112 (2009).

GOV'T ACCOUNTABILITY OFFICE, AVIATION SAFETY: POTENTIAL STRATEGIES TO ADDRESS AIR AMBULANCE SAFETY CONCERNS, GAO-09-627T (2009).

GOV'T ACCOUNTABILITY OFFICE, AVIATION SECURITY: FEDERAL AIR MARSHAL SERVICE HAS TAKEN ACTIONS TO FULFILL ITS CORE MISSION AND ADDRESS WORKFORCE ISSUES, BUT ADDITIONAL ACTIONS ARE NEEDED TO IMPROVE WORKFORCE SURVEY, GAO-09-273 (2009),

GOV'T ACCOUNTABILITY OFFICE, AVIATION SECURITY: PRELIMINARY OBSERVATIONS ON TSA'S PROGRESS AND CHALLENGES IN MEETING THE STATUTORY MANDATE FOR SCREEINING AIR CARGO ON PASSENGER AIRCRAFT, GAO-09-422T (2009).

GOV'T ACCOUNTABILITY OFFICE, AVIATION SECURITY: STATUS OF TRANSPORTATION SECURITY INSPECTOR WORKFORCE, GAO-09-123R (2009).

GOV'T ACCOUNTABILITY OFFICE, AVIATION SECURITY: TSA'S COST AND PERFORMANCE STUDY OF PRIVATE-SECTOR AIRPORT SCREENING GAO-09-27R (2009).

GOV'T ACCOUNTABILITY OFFICE, HOMELAND DEFENSE: ACTIONS NEEDED TO IMPROVE MANAGEMENT OF AIR SOVEREIGNTY ALERT OPERATIONS TO PROTECT U.S. AIRSPACE, GAO-09-184 (2009).

GOV'T ACCOUNTABILITY OFFICE, HOMELAND DEFENSE: ACTIONS NEEDED TO ADDRESS MANAGEMENT OF AIR SOVEREIGNTY ALERT OPERATIONS TO PROTECT U.S. AIRSPACE, GAO-09-612T (2009).

GOV'T ACCOUNTABILITY OFFICE, NATIONAL AIRSPACE SYSTEM: FAA REAUTHORIZATION ISSUES ARE CRITICAL TO SYSTEM TRANSFORMATION AND OPERATIONS, GAO-09-377T (2009).

GOV'T ACCOUNTABILITY OFFICE, NEXT GENERATION AIR TRANSPORTATION SYSTEM: STATUS OF TRANSFORMATION AND ISSUES ASSOCIATED WITH MIDTERM IMPLEMENTATION OF CAPABILITIES, GAO-09-479T (2009).

GOV'T ACCOUNTABILITY OFFICE, RESPONSES TO QUESTIONS FOR THE RECORD: FEBRUARY 11, 2009, HEARING ON THE FAA REAUTHORIZATION ACT OF 2009, GAO-09-467R (2009).

GOV'T ACCOUNTABILITY OFFICE, TRANSPORTATION SECURITY ADMINISTRATION'S SUSPENSION OF THE BUTANE LIGHTER BAN ONBOARD COMMERCIAL AIRCRAFT, GAO-09-177R (2008).

GOV'T ACCOUNTABILITY OFFICE, TRANSPORTATION SECURITY: COMPREHENSIVE RISK ASSESSMENTS AND STRONGER INTERNAL CONTROLS NEEDED TO HELP INFORM TSA RESOURCE ALLOCATION, GAO-09-492 (2009).

ANDREW J. HARAKAS, LITIGATING THE AVIATION CASE: FROM PRE-TRIAL TO CLOSING ARGUMENT (2008).

DOO HWAN KIM, ESSAYS FOR THE STUDY OF THE INTERNATIONAL AIR AND SPACE LAW (2008).

DAVID RANDALL PETERMAN, BART ELIAS, & JOHN FRITTELLI, TRANSPORTATION SECURITY: ISSUES FOR THE 111TH CONGRESS, Congressional Research Service (2009).

JOSEPH J. VACEK & BRETT D VENHUIZEN, AIR LAW: CASES & MATERIALS (2009).

Space

International Documents

G.A. Res. 63/40, Prevention of an arms race in outer space, A/RES/63/40 (Dec. 2, 2008)

G.A. Res. 63/68, Transparency and confidence-building measures in outer space activities, U.N. Doc. A/RES/63/68 (Dec. 2, 2008)

G.A. Res. 63/90, International cooperation in the peaceful uses of outer space, U.N. Doc. A/RES/63/90 (Dec. 5, 2008).

International Telecommunications Unions, Resolution 73 – Information and communication technologies and climate change (Johannesburg, 2008), WTSA-08 – Resolution 73 (2008).

Statement by the President of the Security Council, U.N. Doc. S/PRST/2009/7 (Apr. 13, 2009).

Legislation and Regulations

European Union

Commission Decision of 20 April 2009 establishing an expert group on the security of the European GNSS systems (Text with EEA relevance) (2009/334/EC), 2009 J.O. (L 101) 22.

European Parliament resolution of 20 November 2008 on the European space policy: how to bring space down to earth on November 20, 2008, Eur. Parl Doc. P6_TA(2008)0564 (2008).

Russian Federation

РАСПОРЯЖЕНИЕ Правительства РФ от 24.12.2008 N 1961-р

О преобразовании закрытого военного городка №1 в закрытое административно-территориальное образование - поселок Звездный городок московской области (2009)

ФЕДЕРАЛЬНЫЙ ЗАКОН от 14.02.2009 N 22-ФЗ “О НАВИГАЦИОННОЙ ДЕЯТЕЛЬНОСТИ” (принят ГД ФС РФ 30.01.2009)

South Africa

South African National Space Agency Act 36 of 2008.

United States

Army Regulation 900–1, Army Space Activities: Department of the Army Space Policy (2009).

H.B. 994, 25th Leg., Reg. Sess. (Haw. 2009).

Satellite Licensing Procedures, 73 Fed. Reg. 70897 (Nov. 24, 2008).

Satellite Licensing Procedures, 74 Fed. Reg. 9962 (Mar. 9, 2009).

Cases

European Union

Summary of Commission Decision of 4 April 2007 declaring a concentration to be compatible with the common market and the EEA Agreement (Case COMP/M.4403 — Thales/ Finmeccanica/Alcatel Alenia Space & Telespazio) (2009/C 34/05) 2009 J.O. (C 34) 5.

United States

Globalstar, Inc. v. FCC, No. 08-1046, 2009 U.S. App. LEXIS 9422 (D.C. Cir. 2009).

EchoStar Satellite Corp. v. Ultraview Satellite, Inc., No. 01-cv-00739-JLK, 2009 U.S. Dist. LEXIS 31685 (D. Col. 2009).

Beleson v. Schwartz, 599 F. Supp. 2d 519 (S.D.N.Y. 2009).

PPV Connection, Inc. v. Rodriguez, Civil No. 08-1046 (FAB), 2009 U.S. Dist. LEXIS 33134 (D.P.R. 2009).

Doe v. DISH Network Serv., LLC, No. 3:09-CV-93-HEH, 2009 U.S. Dist. LEXIS 34052 (E.D. Va. 2009).

DIRECTV, Inc. v. Levin, 2009 Ohio 636 (Ohio Ct. App. 2009).

U.S. Administrative Decisions

ASRC Research & Technology Solutions, LLC, B-400217; B-400217.2, (Gov't Accountability Office 2008).

Finding of No Significant Impact, 74 Fed. Reg. 5715 (Jan. 30, 2009).

Honeywell Technology Solutions, Inc., B-400771; B-400771.2, (Gov't Accountability Office Jan. 27, 2009)

In the Matter of L-3 Communications Titan Corporation Application for Authority to Operate a Mobile Earth Station to Provide Land Mobile Satellite Service in the Ku-Band, File No. SES-LIC-20070322-00396 (Fed. Comm. Comm'n Mar. 16, 2009).

In the Matter of Northrop Grumman Space & Mission Systems Corporation Applications for Authority to Operate a Global Satellite System Employing Geostationary Satellite Orbit and Non-Geostationary Satellite Orbit Satellites in the Fixed-Satellite Service in the Ka-band and V-band (Fed. Comm. Comm'n Feb. 24, 2009).

In the Matter of Robert M. Franklin, Transferor, Inmarsat, plc, Transferee, IB Docket No. 08-143 (Fed. Comm. Comm'n Jan. 16, 2009).

In the Matter of SES Americom, Inc. Licensee of Satcom C-3 Satellite, File No. EB-08-SE-555 (Fed. Comm. Comm'n Feb. 27, 2009).

Notice of Approval on a Record of Decision (ROD) for the Spaceport America Commercial Launch Site, Sierra County, 73 Fed. Reg. 79539 (Dec. 29, 2008).

PlanetSpace, Inc., B-401016; B-401016.2, (Gov't Accountability Office Apr. 22, 2009).

SkyTerra Communications, Inc., Transferor, and Harbinger Capital Partners Funds, Transferee, Seek FCC Consent to Transfer Control of SkyTerra Subsidiary, LLC, IB Docket No. 08-184 (Fed. Comm. Comm'n May 4, 2009).

Articles

Setsuko Aoki, *Introduction to the Japanese Basic Space Law of 2008/ Überblick über das Japanische Weltraumbasisge-*

setz 2008/ Introduction à la loi (de base) spatiale 2008 Japonaise, 2008 ZLW 585 (2008).

P.J. Blount, *The ITAR Treaty and Its Implications for U.S. Space Exploration Policy and the Commercial Space Industry*, 73 J. AIR L. & COM. 705 (2008).

Nikhil D. Cooper, *Circumventing Non-Appropriation: Law and Development of United States Space Commerce*, 36 HASTINGS CONST. L.Q. 457 (2009).

Jeff Foust, *The Uphill Battle for Export Control Reform*, THE SPACE REVIEW, DEC. 1, 2008, http://www.thespacereview.com/article/1259/1.

Adam E. Frey, *Defense of US Space Assets: A Legal Perspective*, AIR & SPACE POWER JOURNAL, Winter 2008 at 75.

Annette Froehlich, *Analyse de la proposition sur la communautarisation du Centre Spatial Guyanais (CSG)/ Zum französischen Vorschlag, den Weltraumbahnhof in Französisch Guyana zu einer Einrichtug der EU zu machen/ Analyzing the French Proposal of Transforming the Space Center in French Guyana into an EU-Institution*, 2008 ZLW 558 (2008).

Gérardine Meishan Goh, *Softly, Softly Catchee Monkey: Informalism and the Quiet Development of International Space Law*, 87 NEB. L. REV. 725 (2009).

Sang Wook Daniel Han, *Global Administrative Law: Global Governance of the Global Positioning System and Galileo*, 14 ILSA J. INT'L & COMP. L. 571 (2008).

Stephan Hobe, Oliver Heinrich, Irina Kerner, & Bernhard Schmidt-Tedd, *Ten Years of Cooperation between ESA and EU: Current Issues / 10 Jahre Zusammenarbeit zwischen ESA und EU: gegenwärtige Probleme / 10 années de coopération entre ESA et l'UE: problèmes actuels*, 2009 ZLW 49 (2009).

Diane Howard, *Achieving a Level Playing Field in Space-Related Public-Private Partnerships: Can Sovereign Immunity Upset the Balance?*, 73 J. AIR L. & COM. 723 (2008).

Ram Jakhu & Karan Singh, *Space Security and Competition for Radio Frequencies and Geostationary Slots / Weltraumsicherheit und der Zugang zu Radiofrequenzen und Position in der Geostationären Umlaufbahn / Sécurité spatiale et la compétition relative aux fréquences radioélectriques et aux positions en orbite géostationnaire*, 2009 ZLW 74 (2009).

Ram Jakhu & Maria Buzdugan, *Development of the Natural Resources of the Moon and Other Celestial Bodies: Economic and Legal Aspects*, 6 ASTROPOLITICS 201 (2008).

Li Juqian, *Legality and Legitimacy: China's ASAT Test*, 5 CHINA SECURITY 45 (2009).

Stefan A. Kaiser, *Viewpoint: Chinese Anti-Satellite Weapons: New Power Geometry and New Legal Policy*, 6 ASTROPOLITICS 313 (2008).

Doo Hwan Kim, *Space Law in Korea: Existing Regulations and Future Tasks/ Koreanisches Weltraumrecht: Regelungen und Perspektiven/ Le droit spatial Coréen: règlements et perspectives*, 2008 ZLW 571 (2008).

Joosung J. Lee, LEGAL ANALYSIS OF SEA LAUNCH LICENSE: NATIONAL SECURITY AND ENVIRONMENTAL CONCERNS, 24 SPACE POL'Y 104 (2008).

Michael Listner, *A Bilateral Approach from Maritime Law to Prevent Incidents in Space*, THE SPACE REVIEW, Feb. 16, 2009, http://www.thespacereview.com/article/1309/1.

Martha Mejía-Kaiser, *Informal Regulations and Practices in the Field of Space Debris Mitigation,* 34 AIR & SPACE L. 21 (2009).

Pablo M. J. Mendes de Leon, *A Tour d'Horizon of Contemporary Issues in Air and Space Law*, 8 ISSUES IN AVIATION L. & POL'Y_ (2009).

Christopher Miles, comment, *Assessing the Need for an International Patent Regime for Inventions in Outer Space*, 11 TUL. J. TECH. & INTELL. PROP. 59 (2008).

Michael C. Mineiro, *Law and Regulation Governing U.S. Commercial Spaceports: Licensing, Liability, and Legal Challenges*, 73 J. AIR L. & COM. 759 (2008).

Michael J. Noble, *Export Controls and United States Space Power*, 6 ASTROPOLITICS 251 (2008).

Monroe E. Price, Satellite Transponders and Free Expression, 27 CARDOZO ARTS & ENT. L.J. 1 (2009).

Lucien Rapp, *When France Puts Its Own Stamp on the Space Law Landscape: Comments on Act No. 2008-518 of 3 June 2008 Relative to Space Operations*, 34 AIR & SPACE L. 87 (2009).

Álvaro Fabricio dos Santosa & José Monserrat Filho, *Need for a National Brazilian Centre of Space Policy and Law Studies*, 24 SPACE POL'Y 6 (2008).

Scott J. Shackelford, *The Tragedy of the Common Heritage of Mankind,* 28 STAN. ENVTL. L.J. 109 (2009).

Hirotaka Watanabe, *The Kennedy Administration and Project Apollo: International Competition and Cooperation through Space Policy*, 56 OSAKA U.L. REV. 31 (2009).

Brian Weedan, *Alternatives to a space weapons treaty,* BULLETIN OF THE ATOMIC SCIENTISTS, Apr. 17, 2009, http://thebulletin.org/web-edition/op-eds/alternatives-to-space-weapons-treaty.

Gabriele Wohl, *Outer Space, Inc.: Transmitting Business, Ethics, and Policy "Across the Universe"*, 111 W.V. L. Rev. 311 (2008).

Cynthia B. Zhang, *Do as I Say, Not as I Do—Is Star Wars Inevitable? Exploring the Future of International Space Regime in the Context of the 2006 U.S. National Space Policy*, 34 RUTGERS COMPUTER & TECH. L.J. 422 (2008).

Haifeng Zhao, *The Status Quo and the Future of Chinese Space Legislation / Der Status Quo und die Zukunft von chinesischem Weltraumrecht / Le status quo et l'avenir du droit spatial chinois*, 2009 ZLW 94 (2009).

Books and Reports

AIR AND SPACE LAW: SELECTED DOCUMENTS (Willem-Jan van der Wolf & Claudia Tofan eds.) (2008).

AM. INST. AERONAUTICS, THE ROLE OF SPACE IN ADDRESSING AMERICA'S NATIONAL PRIORITIES (2009).

NATALIE BORMANN & MICHAEL SHEEHAN, SECURING OUTER SPACE (2009).

CHRISTIAN BRÜNNER & EDITH WALTER, NATIONALES WELTRAUMRECHT: NATIONAL SPACE LAW: DEVELOPMENT IN EUROPE - CHALLENGES FOR SMALL COUNTRIES (2008).

LUCA CODIGNOLA & KAI-UWE SCHROGL, HUMANS IN OUTER SPACE – INTERDISCIPLINARY ODYSSEYS (2008).

CONGRESSIONAL BUDGET OFFICE, OPTIONS FOR DEPLOYING MISSILE DEFENSES IN EUROPE (2009).

CATHERINE DOLDIRINA, INSPIRE: A REAL STEP FORWARD IN BUILDING AN INTEROPERABLE AND UNIFIED SPATIAL INFORMATION INFRASTRUCTURE FOR EUROPE?, ESPI Perspectives 20 (2009).

FAA/AST, ANALYSIS OF HUMAN SPACE FLIGHT SAFETY: REPORT TO CONGRESS (2008).

FAA/AST, INTRODUCTION TO U.S. EXPORT CONTROLS FOR THE COMMERCIAL SPACE INDUSTRY (2008).

FAA/AST, STATE SUPPORT FOR COMMERCIAL SPACE ACTIVITIES (2009).

FLORIDA LEGISLATURE OFFICE OF PROGRAM POLICY ANALYSIS AND GOVERNMENT ACCOUNTABILITY, RESEARCH MEMORANDUM: REVIEW OF SPACE FLORIDA (2009).

GOV'T ACCOUNTABILITY OFFICE, GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITES: ACQUISITION HAS INCREASED COSTS, REDUCED CAPABILITIES, AND DELAYED SCHEDULES, GAO-09-596T (2009).

GOV'T ACOUNTABILITY OFFICE, GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITES: ACQUISITION IS UNDER WAY, BUT IMPROVEMENTS NEEDED IN MANAGEMENT AND OVERSIGHT, GAO-09-323 (2009).

GOV'T ACCOUNTABILITY OFFICE, GLOBAL POSITIONING SYSTEM: SIGNIFICANT CHALLENGES IN SUSTAINING AND UPGRADING WIDELY USED CAPABILITIES, GAO-09-325 (2009).

GOV'T ACCOUNTABILITY OFFICE, NASA: ASSESSMENTS OF SELECTED LARGE-SCALE PROJECTS, GAO-09-306SP (2009).

GOV'T ACCOUNTABILITY OFFICE, NASA PROJECTS NEED MORE DISCIPLINED OVERSIGHT AND MANAGEMENT TO ADDRESS KEY CHALLENGES, GAO-09-436T (2009).

GOV'T ACCOUNTABILITY OFFICE, NASA WORKFORCE: RESPONSES TO FOLLOW-UP QUESTIONS REGARDING THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION'S USE OF TERM APPOINTMENTS, GAO-09-356R (2009).

GOV'T ACCOUNTABILITY OFFICE, NATIONAL APPLICATIONS OFFICE CERTIFICATION REVIEW, GAO-09-105R (2008).

GOV'T ACCOUNTABILITY OFFICE, PROPERTY MANAGEMENT: NASA'S GOAL OF INCREASING EQUIPMENT REUTILIZATION MAY FALL SHORT WITHOUT FURTHER EFFORTS, GAO-09-187 (2009).

GOV'T ACCOUNTABILITY OFFICE, SPACE ACQUISITIONS: GOVERNMENT AND INDUSTRY PARTNERS FACE SUBSTANTIAL CHALLENGES IN DEVELOPING NEW DOD SPACE SYSTEMS, GAO-09-648T (2009).

L. ELAINE HALCHIN, OTHER TRANSACTIONS AUTHORITY, Congressional Research Service (2008).

INDEPENDENT WORKING GROUP ON MISSILE DEFENSE, THE SPACE RELATIONSHIP, & THE TWENTY-FIRST CENTURY, 2009 REPORT (2009).

INTERNATIONAL SPACE EXPLORATION COORDINATION GROUP, 2008 ANNUAL REPORT (2009).

JOINT CHIEFS OF STAFF, SPACE OPERATIONS, Joint Publication 3-14 (2009).

RICHARD KAUFMAN, HENRY HERTZFELD, & JEFFREY LEWIS, SPACE, SECURITY AND THE ECONOMY (2008).

DOO HWAN KIM, ESSAYS FOR THE STUDY OF THE INTERNATIONAL AIR AND SPACE LAW (2008).

YUKIKO KODACHI, THE EUROPEAN UNION DRAFT CODE OF CONDUCT – AN OPPORTUNITY FOR JAPANESE-EUROPEAN COOPERATION, ESPI Perspective 19 (2009).

THOMAS GANGALE, THE DEVELOPMENT OF OUTER SPACE SOVEREIGNTY AND PROPERTY RIGHTS IN INTERNATIONAL SPACE LAW (2009).

AJEY LELE & GUNJAN SINGH, SPACE SECURITY AND GLOBAL COOPERATION (2009).

FRANCIS LYALL & PAUL B LARSEN, SPACE LAW: A TREATISE (2009).

NASA, COLUMBIA CREW SURVIVAL INVESTIGATION REPORT, NASA/SP-2008-565 (2008).

NATIONAL RESEARCH COUNCIL, BEYOND "FORTRESS AMERICA": NATIONAL SECURITY CONTROLS ON SCIENCE AND TECHNOLOGY IN A GLOBALIZED WORLD (2009).

VIRGILIU POP, WHO OWNS THE MOON?: EXTRATERRESTRIAL ASPECTS OF LAND AND MINERAL RESOURCES OWNERSHIP (2008).

DANIEL A. PORRAS, THE NEED FOR TIMEOUS COMPLETION OF THE PRELIMINARY DRAFT PROTOCOL TO THE CAPE TOWN CONVENTION ON MATTERS SPECIFIC TO SPACE ASSETS, ESPI Perspectives 22 (2009).

NINA-LOUISA REMUSS, THE NEED TO COUNTER SPACE TERRORISM – A EUROPEAN PERSPECTIVE, ESPI Perspectives 17 (2009).

REPORT OF THE CONFERENCE ON DISARMAMENT TO THE GENERAL ASSEMBLY OF THE UNITED NATIONS, U.N. Doc. CD/1853 (2008).

KAI-UWE SCHROGL, CHARLOTTE MATHIEU & AGNIESZKA LUKASZCZYK, THREATS, RISKS AND SUSTAINABILITY – ANSWERS BY SPACE (2009).

KAI-UWE SCHROGL, CHARLOTTE MATHIEU, JEAN BRUSTON & SEBASTIAN RIEDER, GOVERNANCE OF SPACE ACTIVITIES IN AN EVOLVING EUROPEAN FRAMEWORK – HOW TO ACHIEVE COHERENCE AND EFFECTIVENESS?, ESPI Perspectives 18 (2009).

V. V. SEMENIAKA & IURII SERHIIOVYCH SHEMSHUCHENKO, STRAKHUVANNIA U SFERI KOSMICHNOÏ DIIAL'NOSTI : TEORETYKO-PRAVOVI ZASADY (2008).

SENATE STANDING COMMITTEE ON ECONOMICS, LOST IN SPACE? SETTING A NEW DIRECTION FOR AUSTRALIA'S SPACE SCIENCE AND INDUSTRY SECTOR (2008).

FRANK SLIJPER, FROM VENUS TO MARS: THE EUROPEAN UNION'S STEPS TOWARDS THE MILITARISATION OF SPACE (2008).

UN FIRST COMMITTEE REPORT ON PREVENTION OF AN ARMS RACE IN OUTER SPACE , U.N. Doc. A/63/388 (2008).

UNIDIR, SECURITY IN SPACE: THE NEXT GENERATION (2008).

LOTTA VIIKARI, DISPUTE RESOLUTION IN THE SPACE SECTOR : PRESENT STATUS AND FUTURE PROSPECTS (2008).

YUN ZHAO, SPACE COMMERCIALIZATION AND THE DEVELOPMENT OF SPACE LAW FROM A CHINESE LEGAL PERSPECTIVE (2009).

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