REGULATING SPACE: INNOVATION, LIBERTY, AND INTERNATIONAL OBLIGATIONS

HEARING

BEFORE THE

SUBCOMMITTEE ON SPACE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED FIFTEENTH CONGRESS

FIRST SESSION

MARCH 8, 2017

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REGULATING SPACE: INNOVATION, LIBERTY, AND INTERNATIONAL OBLIGATIONS

WEDNESDAY, MARCH 8, 2017

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON SPACE,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Subcommittee met, pursuant to call, at 10:07 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Brian Babin [Chairman of the Subcommittee] presiding.

LAMAR S. SMITH, Texas
CHAIRMAN

EDDIE BERNICE JOHNSON, Texas
RANKING MEMBER

Congress of the United States
House of Representatives
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
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Regulating Space: Innovation, Liberty, and International Obligations

Wednesday, March 8, 2017
10:00 a.m.
2318 Rayburn House Office Building

Witnesses

Ms. Laura Montgomery, Attorney and Sole Proprietor, Ground Based Space Matters, LLC

Dr. Eli Dourado, Senior Research Fellow and Director, Technology Policy Program, Mercatus Center, George Mason University

Mr. Douglas L. Loverro, Former Deputy Assistant Secretary of Defense for Space Policy, U.S. Department of Defense

Mr. Dennis J. Burnett, Adjunct Professor of Law, University of Nebraska-Lincoln, College of Law

Dr. Henry B. Hogue, Specialist in American National Government, Congressional Research Service

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

Charter

TO:	Members, Committee on Science, Space, and Technology
FROM:	Majority Staff, Committee on Science, Space, and Technology
DATE:	March 8, 2017
SUBJECT:	Subcommittee on Space Hearing: "Regulating Space: Innovation, Liberty, and International Obligations"

On Wednesday, March 8, 2016, at 10:00 a.m. in Room 2318 of the Rayburn House Office Building, the Committee on Science, Space, and Technology, Subcommittee on Space will hold a hearing titled, "Regulating Space: Innovation, Liberty, and International Obligations."

Hearing Purpose

The hearing will examine U.S. international obligations in light of new and innovative space activities.

Witnesses

- **Ms. Laura Montgomery**, Attorney and Sole Proprietor, Ground Based Space Matters, LLC
- **Dr. Eli Dourado**, Senior Research Fellow and Director, Technology Policy Program, Mercatus Center, George Mason University
- **Mr. Doug Loverro**, Former Deputy Assistant Secretary of Defense for Space Policy
- **Mr. Dennis J. Burnett**, Adjunct Professor of Law, University of Nebraska-Lincoln, College of Law
- **Dr. Henry B. Hogue**, Specialist in American National Government, Congressional Research Service

Staff Contact

For questions related to the hearing, please contact Mr. Tom Hammond, Staff Director, Space Subcommittee, Dr. Michael Mineiro, Counsel, Space Subcommittee, or Ms. Sara Ratliff, Policy Assistant, Space Subcommittee, at 202-225-6371.

Chairman BABIN. The prayer—excuse me. The Chair is authorized to declare recesses of the Subcommittee at any time. We need prayers, don't we?

Welcome to today's hearing titled "Regulating Space: Innovation, Liberty, and International Obligations." I recognize myself for five minutes for an opening statement.

The Outer Space Treaty celebrated its 50th anniversary just last month. It was negotiated at the height of the Cold War and reflected two very distinct philosophies: communism and liberty. The Soviet Union sought to prevent any non-state actors from operating in space. The United States, however, argued that space should be free for exploration and use for all and by all, including the private sector and individuals. Fortunately, the United States' position was the one accepted.

As part of that compromise, the United States agreed, in Article VI of the Treaty, to authorize and supervise private sector space activities. When the Senate ratified the Outer Space Treaty 50 years ago, private free enterprise in outer space was an idea, but not yet a reality.

Today, not only is there U.S. free enterprise in outer space, it is innovating at an unprecedented pace. American companies are developing and investing in technology and spacecraft to conduct non-traditional private sector space activities, such as satellite servicing, manufacturing, human habitation, and space resource utilization.

Recognizing that American free enterprise and innovation in outer space may implicate our international obligations, Congress directed the Obama Administration to assess existing authorization and supervision authorities. Last year, the Obama Administration recommended that Congress expand the regulatory authority of the Secretary of Transportation. Well, the purpose of today's hearing is to inform Congress as it assesses U.S. international obligations in light of new and innovative private space activities.

I hope it will also inform the incoming Trump Administration as it formulates its own positions on the topic. I look forward to working with the Administration going forward, and plan to invite them to testify in the future once they have developed a formal position.

I hope that today's witnesses will identify fundamental national interests at stake, examine our international obligation to authorize and supervise space activities, expand on the options that we have at our disposal to meet authorization and supervise obligations, and help us all assess and understand different paths forward. The course we chart today may not seem very important, but in the long run the decisions we make will have far-reaching consequences.

I recognize that today there is no consensus opinion on what should be done. I also recognize that there are many different ideas. Frankly, this is a good thing. This is a serious issue, and we should do our best to get it right, and that entails examining all the possible solutions.

I have serious reservations with the Section 108 legislative proposal. While it may be well intentioned, it is ill conceived. It places the burden of demonstrating consistency with international obligations, foreign policy, and national security requirements of the

United States with the applicant, leaving the government to decide at its own discretion, without clear limitations, whether an activity should go forward. It grants expansive discretionary regulatory authority, essentially with the ability to regulate any or all aspects of private sector space activities. It also fails to identify or assess alternatives to a Department of Transportation agency licensing and regulatory construct. We must not just presume that a traditional agency licensing authority granted to the Department of Transportation is the best way forward.

This hearing will be an important step as the Committee develops legislation that will streamline the regulatory process, limit burdensome government intrusion, promote American innovation and investment, and satisfy our international obligations. We must find a way to uphold our cherished principles of liberty and prime the pump of innovation. I believe that we can do this while also satisfying our international obligations.

If done correctly, we can expand American prosperity and influence. If done haphazardly, we could smother the embers of creativity and diminish our leadership in space. I believe it is one of the fundamental space policy questions of our time.

I want to thank today's witnesses for joining us as we discuss these important issues, and I look forward to hearing your testimony.

[The prepared statement of Chairman Babin follows:]

COMMITTEE ON
SCIENCE, SPACE, & TECHNOLOGY
Lamar Smith, Chairman

For Immediate Release
March 8, 2017

Media Contact: Kristina Baum
(202) 225-6371

Statement of Space Subcommittee Chairman Brian Babin (R-Texas)
Regulating Space: Innovation, Liberty, and International Obligations

Chairman Babin: The Outer Space Treaty celebrated its 50th anniversary just last month. It was negotiated at the height of the Cold War and reflected two very distinct philosophies – communism and liberty. The Soviet Union sought to prevent any non-state actors from operating in space. The United States, however, argued that space should be free for exploration and use by all, including the private sector and individuals. Fortunately, the United States' position was accepted. As part of that compromise, the United States agreed, in Article VI ("Six") of the Treaty, to authorize and supervise private sector space activities.

When the Senate ratified the *Outer Space Treaty* fifty years ago, private free enterprise in outer space was an idea, but not yet a reality.

Today, not only is there U.S. free enterprise in outer space, it is innovating at an unprecedented pace. American companies are developing and investing in technology and spacecraft to conduct "non-traditional" private sector space activities, such as satellite servicing, manufacturing, human habitation, and space resource utilization.

Recognizing that American free enterprise and innovation in outer space may implicate our international obligations, Congress directed the Obama Administration to assess existing "authorization and supervision" authorities.

Last year, the Obama Administration recommended that Congress expand the regulatory authority of the Secretary of Transportation.

The purpose of today's hearing is to inform Congress as it assesses U.S. international obligations in light of new and innovative private space activities. I hope it will also inform the incoming Trump Administration as it formulates its own positions on the topic. I look forward to working with the Administration going forward, and plan to invite them to testify in the future once they have developed a formal position.

I hope that today's witnesses will identify fundamental national interests at stake, examine our international obligation to authorize and supervise space activities, expand on the options we have at our disposal to meet authorization and supervision obligations, and help us all assess and understand different paths forward. The course we chart today may not seem very important, but in the long-run the decisions we make will have far-reaching consequences.

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This hearing will be an important step as the Committee develops legislation that will streamline the regulatory process, limit burdensome government intrusion, promote American innovation and investment, and satisfy our international obligations.

We must find a way to uphold our cherished principles of liberty and prime the pump of innovation. I believe we can do this while also satisfying our international obligations. If done correctly, we can expand American prosperity and influence. If done haphazardly, we could smother the embers of creativity and diminish our leadership in space. I believe it is one of the fundamental space policy questions of our time.

I thank today's witnesses for joining us as we discuss these important issues and I look forward to hearing your testimony.

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Chairman BABIN. And now at this time I would like to introduce into the record some letters that I have, and I will do so. I ask unanimous consent to enter into the record letters of the Heritage Foundation, the Competitive Enterprise Institute, and Tech Freedom, and a paper published by the Niskanen Center. These letters and the paper were shared with Minority staff in advance of the hearing, and without objection I so order.

[The information appears in Appendix II]

Chairman BABIN. I now recognize the Ranking Member, the gentleman from California, for an opening statement. Mr. Bera.

Mr. BERA. Great. Thank you, Mr. Chairman.

Good morning, and welcome to our distinguished panel. Again, I want to thank the Chairman for calling this hearing. This is a very timely topic, and in fact, as the Subcommittee embarks on the 115th Congress, I think this is going to be a very vibrant time in how Congress, how our federal government and NASA approach space, so I look forward to working with you and making this one of the most bipartisan, vibrant committees and subcommittees in Congress.

Think about where we were over 50 years ago in 1967. It was two years before Neil Armstrong was even going to land on the Moon. Yet we were thinking about some of these issues, and when the United States signed the Outer Space Treaty in 1967, thankfully, as the Chairman already pointed out, our approach to being open to the private sector getting involved in space was the one that won out. But we had no way of knowing where we would be in 2017, and if you think about how rapidly things have moved in the last decade with entrepreneurs, innovators moving into commercial space travel, that's the challenge for us at this juncture is how do we move forward.

In 2015, we passed the Commercial Space Launch Competitiveness Act and directed the Office of Science and Technology Policy to make some recommendations to Congress, and what they recommended for us was an authorization and supervision approach that would prioritize safety, utilize existing authorities, minimize burdens to commercial space transportation, promote the U.S. commercial space sector, and meet the U.S. obligations under international treaties. So there's a lot in there.

I think the challenge for this Committee and all of us moving forward is, as we look at the private sector getting more involved in low-Earth orbit, as we look at more countries—you know, take India, for example, as they're rapidly getting involved, how do we put together a framework that does protect the assets that are up there that in some ways acts an air traffic control managing the lanes that are there, minimizes the safety risks. We've got to work liability issues and other issues. But at the same time, we don't want to stifle that creativity and innovation, so you know, not easy issues to work through, but the issues are incredibly important for us to work through in order to do our jobs so we can give some clarity to those entrepreneurs and those that are entering the field but understanding that we've got to have the right balance between the public sector—there are certain things that only NASA and the federal government can do, you know, much like our mission to Mars. Again, you'll me say we ought to set that goal and get there

by 2033 but that's also going to be a public-private partnership where we're going to be working amongst others.

I look forward to the testimony. In particular, I hope some of today's discussions can provide some clarity on the following questions. What is meant by continuing supervision as stated in Article VI of the Outer Space Treaty? Can our obligations under Article VI be met by existing authorities, and if not, why not? And how would the U.S. government actually be able to enforce compliance once a mission is launched? What are the potential risks of regulating or not regulating non-governmental missions that are not currently covered under existing government authorities? And is the U.S. government exposed to liabilities by granting mission authorization or approval? Again, I think those are some of the things that we need to work through.

Again, I look forward to a vibrant 115th Congress serving with the Chairman and the broader Committee, and again, I think this is a very timely topic for where we find ourselves.

Thank you. I'll yield back.

[The prepared statement of Mr. Bera follows:]

OPENING STATEMENT
Ranking Member Ami Bera (D-CA)
of the Subcommittee on Space

House Committee on Science, Space, and Technology
Subcommittee on Space
"Regulating Space: Innovation, Liberty, and International Obligations"
March 8, 2017

Good morning. And welcome to our distinguished panel. Thank you Mr. Chairman for calling this hearing.

In 1967, capabilities such as satellite repair and refueling, orbital habitats, and extraction of rare-earth elements from the Moon or asteroids were only figments of the imagination; two years before Neil Armstrong walked on the Moon.

Yet 1967 was an important milestone in space exploration: that was the year when the United States signed the Outer Space Treaty. Through a series of seventeen Articles, the Outer Space Treaty outlines principles for what nations can and cannot do in space and on other worlds. In essence, it is the basis of international space law. The Treaty was signed when space travel was in its infancy and at a time when space activities were solely conducted by nation states.

The former Soviet Union had wanted to ban space activity by non-governmental entities. The U.S. urged that the Treaty preserve the possibility of non-governmental space activities because American companies had plans for operating telecommunications satellites.

Fortunately, a compromise was struck. Through Article VI, the treaty explicitly provides for non-governmental activity in space, with a requirement that "States Parties" take responsibility for supervising such non-governmental activity. I use the word fortunately because today, in 2017, we have an exciting, vibrant, and innovative commercial space industry. And the capabilities I mentioned earlier, such as satellite servicing, are closer to becoming a reality. But because existing licensing and regulatory regimes do not address

these non-traditional space activities, further clarity is necessary on how such activities will be authorized and continually supervised in order to comply with the Outer Space Treaty.

In particular, the 2015 Commercial Space Launch Competitiveness Act directed the Office of Science and Technology Policy to recommend to Congress "*an authorization and supervision approach that would prioritize safety, utilize existing authorities, minimize burdens to the commercial space transportation industry, promote the U.S. commercial space sector, and meet U.S. obligations under international treaties*".

The legislative proposal submitted in April 2016 by OSTP would have FAA coordinate an interagency process in which designated agencies would review a proposed mission in relation to specified government interests. For example, the State Department would be responsible for reviewing proposed missions for consistency with the Outer Space Treaty and the Department of Defense would review it for ensuring the protection of national security interests.

Mr. Chairman, I recognize that the OSTP proposal is just one approach. In carrying out our due diligence, this Subcommittee has the responsibility to fully examine the full spectrum of issues related to authorization and continuing supervision and consider the various ways by which this can be achieved.

So I look forward to our witnesses' testimony to help inform our work in this important area of policy. In particular, I hope today's discussion can provide clarity on the following questions:

> *What is meant by "continuing supervision" as stated in Article VI of the Outer Space Treaty? Can our obligations under Article VI be met with existing authorities? If not, why not? How would the U.S. government actually be able to enforce compliance once a mission is launched?*
> *What are the potential risks of regulating or not regulating non-governmental missions that are not currently covered under existing government authorities?*

Is the U.S. government exposed to liabilities by granting "mission authorization" or approval?

How is the safety of NASA and national security space assets impacted under alternative approaches?

Article IX of the Outer Space Treaty requires that studies of outer space and exploration be conducted "so as to avoid their harmful contamination." What are the options for addressing this Treaty obligation as part of a "mission authorization" process for non-governmental entities?

In short, these are not easy issues to address, and they will take time and require hearing from all the relevant stakeholders before we know whether legislation is needed, and if so, what it should entail.

Thank you and I yield back.

Chairman BABIN. Thank you, Mr. Bera. I appreciate that.

And now I recognize the Chairman of our full Committee, the gentleman from Texas, Chairman Smith.

Chairman SMITH. Thank you, Mr. Chairman.

America's future in outer space is bright. From asteroid mining, to private Moon missions, to satellite servicing, there is great promise that American commercial space companies will soon enjoy profits and discover scientific benefits to being in outer space. American visionaries stand ready to facilitate these amazing endeavors.

Unfortunately, the Obama Administration issued a report last year that called for expansive regulations over all types of private space activities. The Obama Administration also requested authority to conduct space traffic management. The request does present an opportunity for Congress to streamline processes and enhance the strength of private sector space activities.

For instance, stakeholders continue to raise concerns that they need certainty to attract investments and that they face pressing short-term launch dates and regulatory risks. We should address these issues and ensure that the Executive Branch does not stifle innovation. Going forward, it should be easier, not harder, for private sector companies to freely explore space.

America faces a crisis of over-regulation. Regulatory overreach has eroded far too many liberties. To the greatest extent possible, we should address public policy challenges without creating new regulations.

It has been eight months since the Obama Administration delivered their message of overly burdensome regulations to Congress but the public debate has shifted in the last few weeks. Instead of presuming that expansive new agency regulatory powers are needed, the conversation is shifting to questions of how to minimize agency regulation or avoid it all together. This is a good sign. It shows that the space community is doing the hard work necessary to develop good law and policy. This is no easy task, particularly when our goal is to empower private investments and discoveries, not impede them.

Let us not forget that the Outer Space Treaty is a treaty of principles, with great discretion granted to the United States on how to implement its obligations.

In last Congress's enacted U.S. Commercial Space Launch Competitiveness Act, Congress made an interpretative declaration of the Outer Space Treaty term "national appropriation," codifying the right of U.S. citizens to legally take possession of space resources. Congress should keep this power in mind as we address the future questions of treaty compliance.

Government space programs explore the unknown, discover new worlds, and develop new science and technologies. But to unlock the great economic potential of outer space, we need the ingenuity, innovation, and interests of our private sector.

Thank you, Mr. Chairman. I yield back.

[The prepared statement of Chairman Smith follows:]

COMMITTEE ON
SCIENCE, SPACE, & TECHNOLOGY
Lamar Smith, Chairman

For Immediate Release
March 8, 2017

Media Contact: Kristina Baum
(202) 225-6371

Statement of Chairman Lamar Smith (R-Texas)
Regulating Space: Innovation, Liberty, and International Obligations

Chairman Smith: Thank you, Chairman Babin, for holding today's hearing.

America's future in outer space is bright. From asteroid mining, to private moon missions, to satellite servicing, there is great promise that American commercial space companies will soon enjoy profits and discover scientific benefits to being in outer space. American visionaries stand ready to facilitate these amazing endeavors.

Unfortunately, the Obama administration issued a report last year that called for expansive regulations over all types of private space activities. The Obama administration also requested authority to conduct space traffic management.

While the request was a non-starter, it does present an opportunity for Congress to streamline processes and enhance the strength of private sector space activities. For instance, stakeholders continue to raise concerns that they need certainty to attract investments and that they face pressing short-term launch dates and regulatory risks.

We should address these issues and ensure that the Executive Branch does not stifle innovation. Going forward, it should be easier, not harder for private sector companies to freely explore space.

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Government space programs explore the unknown, discover new worlds, and develop new science and technologies. But to unlock the great economic potential of outer space, we need the ingenuity, innovation, and self-interests of our private sector. Both are necessary.

I thank our witnesses and look forward to hearing their testimony.

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Chairman BABIN. Yes, sir. Thank you.

Now I recognize the Ranking Member of the full Committee, the gentlewoman from Texas, Ms. Johnson.

Ms. JOHNSON. Thank you very much, and welcome to our witnesses.

Mr. Chairman, I appreciate you holding this hearing on regulating space. I'm really excited about the possibilities for the commercial exploration and utilization of outer space. The many proposals for new private sector space activities exemplify our Nation's capacity for innovation.

However, the pace of technology often moves faster than the policies that should guide its development and use, and so we find ourselves at a key juncture as non-governmental actors and investors seek some policy clarity regarding their proposed activities in space. We have a responsibility to provide them with as clear guidance as possible. We also have a responsibility to uphold our international treaty obligations and, ultimately, to be good stewards of outer space.

Just the other day, I read in the Dallas Morning News, my hometown paper, an article titled "Orbiting junkyard begins to threaten space economy." What will it mean, for example, to have constellations involving hundreds of miniature satellites orbiting the Earth? How do they affect the potential for collisions in space, and what impact would an increasing chance of collisions have on future U.S. government and commercial space activities?

The legislative proposal put forth by the previous Administration included direction such as, I quote, "the Secretary of Transportation, in coordination with the Secretary of Defense, is authorized to examine the planned and actual operational trajectories of space objects and to advise operators as appropriate to facilitate prevention of collisions." While this proposal is one of a number of potential approaches, it or another measure will be needed to ensure that space remains a productive environment for scientific investigation, commerce, and government activities.

Mr. Chairman, I want our commercial space industry to grow and succeed but determining what measures are needed to help ensure the safety and sustainability of space operations will require careful consideration. I hope today's hearing is just the beginning of a series of discussions to closely examine the full spectrum of issues regarding commercial space missions that do not fall under existing regulatory authorities. Our commercial sector, our Nation's space program, and our future in space have much to gain from us taking the time to get it right.

I look forward to our witnesses' testimony. I thank you, and I yield back.

[The prepared statement of Ms. Johnson follows:]

OPENING STATEMENT
Ranking Member Eddie Bernice Johnson (D-TX)

House Committee on Science, Space, and Technology
Subcommittee on Space
"Regulating Space: Innovation, Liberty, and International Obligations"
March 8, 2017

Good morning, and welcome to our witnesses.
Thank you, Mr. Chairman, for holding this hearing on "Regulating Space".

I'm excited about the possibilities for the commercial exploration and utilization of outer space.

The many proposals for new private sector space activities exemplify our nation's capacity for innovation.

However, the pace of technology often moves faster than the policies that should guide its development and use.

And so we find ourselves at a key juncture as non-governmental actors and investors seek some policy clarity regarding their proposed activities in space.

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I hope today's hearing is just the beginning of a series of discussions to closely examine the full spectrum of issues regarding commercial space missions that do not fall under existing regulatory authorities.

Our commercial sector, our nation's space program, and our future in space have much to gain from us taking the time to "get it right".

I look forward to our witness' testimony.

Thank you, and I yield back.

Chairman BABIN. Yes, ma'am. Thank you.

Now let me introduce our witnesses. We appreciate all of you being here.

Ms. Laura Montgomery is our first witness today, Attorney and Sole Proprietor of Ground Based Space Matters, LLC. Ms. Montgomery spent over two decades with the Federal Aviation Administration serving as the Manager of the Space Law Branch in the FAA's Office of the Chief Counsel. Ms. Montgomery received her undergraduate degree from the University of Virginia and her law degree from the University of Pennsylvania. Thank you for being here.

And Dr. Eli Dourado, our second witness today, Senior Research Fellow and Director from the Technology Policy Program at the Mercatus Center of George Mason University. Dr. Dourado is an Adviser to the State Department on International Telecommunication matters and has served on several U.S. delegations to the United Nations. He received his bachelor's degree in economics and political science from the Furman University and his Ph.D. in economics from George Mason University. Thank you for being here.

Mr. Doug Loverro, welcome, our third witness today, former Deputy Assistant Secretary of Defense for Space Policy. In this role, he led departmental activities in international space cooperation and assessment of the national security impacts of commercial space activities. Mr. Loverro worked for the Department of Defense for over 30 years managing national policy for the full range of national security space activities. Mr. Loverro earned a bachelor's degree in chemistry from the United States Air Force Academy, a master's of science in physics from the University of New Mexico, a master's of science in political science from Auburn University, and a master's of business administration from the University of West Florida. Welcome.

Mr. Dennis Burnett, our fourth witness today, is Adjunct Professor of Law at the College of Law at the University of Nebraska in Lincoln. Mr. Burnett also is Chief Counsel, Government and Regulatory Affairs at Kymeta Corporation. Mr. Burnett has done extensive work with all aspects of commercial space activities including preparing and obtaining one of the first NOAA-issued licenses for a U.S. commercial remote sensing satellite system. He has served three terms on the Defense Trade Advisory Group for the U.S. Department of State. He holds a bachelor's degree of science in political science and German from Nebraska Wesleyan University, a juris doctorate from the University of Nebraska College of Law, and a master of law from Georgetown University. Welcome.

Dr. Henry Hogue, our fifth and final witness today, is a specialist in American national government at the Congressional Research Service where he has conducted research in federal government organization and reorganization, the presidential appointments process, and the practices surrounding presidential recess appointments. Dr. Hogue earned his Ph.D. in public administration from the American University.

So I now recognize Ms. Montgomery for five minutes to present her testimony.

TESTIMONY OF MS. LAURA MONTGOMERY, ATTORNEY AND SOLE PROPRIETOR, GROUND BASED SPACE MATTERS, LLC

Ms. MONTGOMERY. Chairman Smith, Ranking Member Johnson, Chairman Babin, and Ranking Member Bera, Members of the Subcommittee, thank you for inviting me to participate today to address the role of Article VI of the Outer Space Treaty and the regulatory responsibilities of the United States.

I respectfully recommend that the United States not regulate new commercial space activities such as lunar habitats, mining, satellite servicing or even lunar beer brewing for the wrong reason, namely the belief that Article VI makes the United States regulate either any particular activity or all activities of U.S. citizens in outer space.

A misunderstanding of the Outer Space Treaty looms as a possible barrier to private space activity and investment because many claim Article VI prohibits commercial operations in outer space unless the government authorizes and supervises, which I'll refer to as regulates or oversees, those activities. Article VI states the activities of non-governmental entities in outer space including the Moon and other celestial bodies shall require authorization and continuing supervision by the appropriate state party to the treaty.

To interpret this as forbidding unauthorized private space activity is wrong for three reasons. First, the treaty doesn't forbid private persons from operating in outer space. Second, it doesn't say that either all activities or any particular activity must be authorized. And finally, Article VI is not under U.S. law self-executing, which means that it does not create an obligation on the private sector unless and until Congress says it does.

By its own terms, Article VI does not prohibit space operations by the commercial sector. First and most simply, it's not in the plain language of the provision. Instead, it leaves it to each country to decide which particular activities require regulation, how that regulation will be carried out, and with how much supervision. If Article VI truly meant that all activities had to be overseen, where would oversight stop? Life is full of activities from brushing one's teeth to playing a musical instrument, which take place now without either federal supervision or continuing federal authorization. Just because those activities take place in outer space does not mean they should suddenly require oversight. Conversely, activities regulated on Earth might not require oversight in space. Accordingly, if Congress hasn't said that a certain activity requires oversight, it doesn't.

Next, Article VI is not self-executing, which means it is not enforceable federal law until Congress passes a law to implement it. Just as the Supreme Court said in Medellin versus Texas, when the Court did not let the President enforce a ruling of the International Court of Justice against the states because Congress had yet to act, Article VI's call for oversight requires in the U.S. system Congressional action in the form of legislation. Accordingly, regulatory agencies should not attempt to enforce this treaty provision by denying licenses or payload authorizations or by attempting to regulate that which they do not have jurisdiction over.

What the government should not do is pass a law so broadly worded as to encompass all activities that could take place in outer space. Due process considerations of notice and transparency mandate that if Congress chooses to regulate space activity, it should identify that activity. The Supreme Court in criminal and First Amendment cases has stated that laws should be drafted so that persons of ordinary intelligence can tell what is forbidden and what is required, and that would be a good model to follow here.

Legislating that all space activities require federal oversight could entrap people engaged in perfectly benign activities. They might reasonably believe that something they do all the time on Earth wasn't a space activity or operation of a space object subject to regulation. What is forbidden or required should be clear and the government must provide adequate notice of what has to be authorized. It would be unnecessarily burdensome and wasteful to regulate everything everyone does everywhere in outer space.

The most certain and long-lasting solution and the one I advocate because it would reduce opportunities for confusion, misunderstanding, and regulatory overreach would be for Congress to prohibit any regulatory agency from denying a U.S. entity the ability to operate in outer space solely on the basis of Article VI. Thank you.

[The prepared statement of Ms. Montgomery follows:]

Testimony of Laura Montgomery

Before the Committee on Science, Space, and Technology

Subcommittee on Space

Regulating Space: Innovation, Liberty, and International Obligations

March 8, 2017, Rayburn Building

Chairman Babin, Ranking Member Bera, and Members of the Subcommittee, thank you for inviting me to participate in this important discussion and to address the role Article VI of the Outer Space Treaty plays in the regulatory responsibilities of the United States. As someone who hopes to see people beyond Low Earth Orbit again in my lifetime, and who hopes to see commercial space operations other than launches, reentries, and communications satellites, I respectfully recommend that the United States not regulate new commercial space activities such as lunar habitats, mining, satellite servicing, or lunar beer brewing for the wrong reason: the belief that Article VI makes the United States regulate either any particular activity or all activities of U.S. citizens in outer space. Regulations already cost American industry, the economy, and the ultimate consumer upwards of four trillion dollars, according to recent research from the Mercatus Center,[1] so we should think carefully before creating more drag on the space sector.

A misunderstanding of the Outer Space Treaty looms as possible regulatory drag, because many claim Article VI of the treaty prohibits operations in outer space unless the government authorizes and supervises—which I'll refer to as "oversees" or "regulates"—those activities. Although Article VI states that "[t]he activities of non-governmental

[1] Bentley Coffey, Patrick McLaughlin, and Pietro Peretto, "The Cumulative Cost of Regulations" (Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, 2016).

entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty," to interpret this as forbidding unauthorized, private space activity is wrong for three reasons. The treaty does not forbid private operators from operating in outer space. It does not say that either all or any particular activity must be authorized. And, finally, Article VI is not, under U.S. law, self-executing, which means that it does not create an obligation on the private sector unless Congress says it does.

In order to put to bed the regulatory uncertainty arising out of these misunderstandings, Congress could take a number of different approaches. The most certain and long-lasting approach, however, and the one that would reduce the opportunities for confusion, misunderstanding, and regulatory overreach, would be for Congress to prohibit any regulatory agency from denying a U.S. entity the ability to operate in outer space on the basis of Article VI.

I. The Treaty Does Not Forbid Private Space Activity, but Leaves it to Each Country to Decide What Activities to Regulate and How to Regulate Them

Article VI of the Outer Space Treaty states:

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

The United States itself is in compliance with Article VI because the treaty leaves the decisions about how to comply with its rather ambiguous terms to each country. By its

own terms, Article VI legally does not and cannot prohibit space operations by the commercial sector. Instead Article VI leaves it to each country to decide which particular activities require regulation, how that regulation will be carried out, and with how much supervision. Accordingly, if Congress hasn't said that a certain activity, such as lunar harp playing, requires authorization and continuing supervision then lunar harp playing does not.

Article VI contains three relevant ambiguous terms that the drafters have left to the different countries to define as they see fit. The terms are "authorization," "continuing supervision," and "activities."

A. Authorization

Article VI says that a country must authorize its nationals' activities. Each country has its own processes and terminology for how it authorizes something. The United States alone authorizes regulated activities by certificate, certification, approval, license, registration, waiver, or exemption. In the United States, Congress determines the nature of the authorization.

B. Continuing supervision

The signatories to the treaty are supposed to require continuing supervision of their nationals. "Continuing supervision" is a matter of frequency. Some agencies conduct annual inspections. Others oversee regulated activities on a daily basis. Some only show up after an accident. The frequency may not be the same, but the supervision may still be called continuous. The nature of the supervision may differ from country to country and all could comply with Article VI's call for continuing supervision.

C. Activities

Finally, and most importantly, the treaty leaves it to each country to decide what activities require supervision and authorization. The treaty does not say *all* activities require oversight. It does not say *which* particular activity requires oversight. Rather, it leaves to each country's policy makers the decision as to where to draw the line. And draw lines they must, so as not to waste resources, unduly burden the industry, or cause confusion. For the United States, the entity that makes those determinations is the U.S. Congress.

Article VI is structured so that a country need not expend resources regulating frivolous, mundane, or non-hazardous activities. Each country may itself decide what activities require authorization and supervision. Thus, if our decision makers haven't decided that a particular activity needs authorization, that activity does not. If Article VI truly meant that all activities had to be overseen, where would oversight stop? Life is full of activities, from brushing one's teeth to playing a musical instrument, which take place now without either federal authorization or continuing federal supervision. Just because those activities take place in outer space does not mean they should suddenly require oversight.

As a matter of past practice, Congress has always identified what activity it wanted regulated, and it has done so with the proper level of specificity that due process considerations of notice and transparency require. Congress required the Federal Communications Commission (FCC) to license satellite transmissions. It required the Department of Transportation (DOT) to license the launch of launch vehicles. Later, it required DOT and the FAA to license the reentry of reentry vehicles as well. Congress also mandated that the seemingly benign activity of taking pictures of Earth—"remote sensing"—requires regulation, too. The point is, each time Congress determined that

something required oversight, whether for reasons of safety, national security, or interference, it identified the activity in question, and it did so with sufficient clarity that persons of ordinary intelligence could tell what was forbidden and what was required.

As a matter of policy, Congress may determine that there are good reasons to expend government resources and taxpayer dollars on a particular activity. Hypothetically, Congress could say that robotic mining of rocks in space really far away does not require regulation because no one lives on that rock, it has no visitors, and no one will get hurt by it. Or, it could say that bringing all those platinum group minerals back to Earth at once will wreak havoc on the economy and then set up an agency to oversee pricing. Even if Congress ignored asteroid mining, it might forbid the reentry of anything large enough to make a crater the size of the Yucatan. There are a number of considerations that may lead to legislation and regulatory oversight. But they are not in Article VI.

Just as there are serious activities that someone may say require oversight, there are a host of other activities that don't. One hears no lamentations over the lack of authorization of space tourists. Yet space tourists exist now. Lunar habitats and space mining do not.

In short, Article VI leaves at least three decisions to each country that signed the Outer Space Treaty: What form should an authorization to take? How frequent must the continuing supervision be? And, what activities require any authorization at all? If Congress doesn't think playing the harp in space requires authorization, then it doesn't, and the U.S. is still in compliance with Article VI.

II. Article VI is not Self-Executing

If a treaty promises, implicitly or explicitly, that the signatories shall enact legislation to implement the treaty, it necessarily requires additional action by another

branch of the government. In the United States, that other branch is the U.S. Congress, and Article VI's call for supervision and authorization requires the kind of policy decisions that are made by our Congress.

As the Supreme Court noted in *Medellin v Texas* in 2008, "not all international law obligations automatically constitute binding federal law enforceable in United States courts." As far back as the early 19th century, in a case called *Neilson v Foster* in which the Court considered a treaty with language similar to that used in Article VI, the Supreme Court said that Congress had to first enact legislation before it could enforce the treaty because the text of the treaty required additional legislative action. With its space legislation, Congress has acted consistently with the Supreme Court's holdings. When Congress decides that an activity requires regulation, it will pass a law, and has done so for launch, reentry, remote sensing from space, and satellite communications.

Because Article VI is not self-executing and thus not enforceable federal law, until Congress acts, regulatory agencies should not treat Article VI as a barrier that applies to commercial actors or claim that it prohibits all or any particular private activity. Indeed, given the close textual analysis that the Supreme Court typically applies to treaties, Article VI's potential obligation on the government does not, even on its own terms, constitute a prohibition on the private sector.

III. Paths Forward

Purely as a legal matter, Article VI should not create a barrier to private activity. However, should there be concerns that this view is not shared by the Executive Branch, Congress has legislative options at its disposal.

A. Legislation Could Clarify that the Executive Branch May Not Prohibit a U.S. National from Conducting an Activity in Space Unless Congress Requires that Activity's Authorization and Continuing Supervision

Legislation could clarify that regulatory agencies may not prohibit a U.S. national from conducting an activity in space unless Congress required federal oversight. This would not be legally necessary, strictly speaking, because this proposal merely reflects current law. However, since the issue of what Article VI means has created legal and regulatory uncertainty, Congress could lay that uncertainty to rest with a directive to regulatory agencies to abstain from using the lack of federal oversight of a particular activity as a reason to deny a payload review, a launch or reentry license, or authorization for satellite transmissions or remote sensing.

There are clear advantages to this path. It would, of course, create certainty, which is helpful to industry's quest for innovation and investment. It would be long-lasting. Most importantly, this path would ensure that before Congress required federal oversight of another activity in space, it would first determine whether a real need existed for that oversight.

B. Let us Not Regulate Everyone for Everything Everywhere in Space

Congress should not require the authorization and supervision of "all" private activities in outer space by private U.S. nationals. The Supreme Court, in criminal and First Amendment cases, has stated that laws should be drafted so that persons of ordinary intelligence can tell what is forbidden and what is required. Should Congress decide to require regulation, it should avoid the temptation to say that "all space activities" require federal oversight. Language like that could entrap people engaged in perfectly benign

activities. They might reasonably believe that something they do all the time on Earth wasn't a "space activity" or "operation of a space object" subject to regulation. What is forbidden or required should be clear and the government must provide adequate notice of what has to be authorized.

Many activities in space shouldn't require regulation, just as many activities we engage in on the ground don't. Just as there are hazardous activities that may require oversight, there are a host of other activities that don't. People will engage in activities that might endanger themselves, their customers, or their neighbors, but they will also perform more ordinary acts. A musician may decide to play the harp on the Moon. The internet tells us that a student group plans a little lunar brewing of beer in the interests of science. Rather than enacting overly broad legislation that transfers all of its legislative powers to a regulatory agency, Congress could take the more measured and transparent approach of deciding which activities require oversight while acknowledging that not all of them do.

Indeed, without the clarity of identifying the activities that require oversight, such a transfer of legislative power would only prolong any regulatory uncertainty as industry faced the possibility of having to obtain permission for every little activity proposed. Typically, if an agency receives a very broad grant of authority the agency will eventually construe that authority to its maximum limits. Were Congress to require authorization and supervision of all activities by U.S. entities in outer space, the incentives on and responsibilities of regulators—such as making sure they don't miss anything, making sure they don't allow something dangerous to happen, and making sure they know what's going on—mean that the agencies will attempt to oversee more than just those activities that are

hazardous to others or pose national security concerns. After all, an agency can't figure out if these threats exist unless it finds out all that an operator plans. Inquiries will be made.

The process an agency undertakes will evolve over time, but each phase will possess its own burdens. Initially, an agency granted broad authority over everything a private U.S. entity does in outer space might review activities on a case-by-case basis. This would mean that regardless of whether an operator planned to install a small nuclear reactor on the Moon or set up a bakery, the agency would have guidelines in place, typically requesting a hazard assessment and a mitigation plan, as well as potential positive safety measures it believed should be employed. Every U.S. citizen doing anything at all in outer space would have to prepare an application responding to the guidelines. The criteria for what was adequate would not exist yet, so what constituted an acceptable application would be unclear. Perversely, if the agency attempted to set standards for activities that had not yet happened, those standards would likely fail to account for lots of variables and unduly constrict what an operator could do. Still the agency would likely want to review the design, the engineering, the maintenance plans, the safety protocols, and the operating plans.

When regulating on a case-by-case basis, an agency that seeks to provide the industry some flexibility will try to avoid imposing the same requirements on everyone regardless of their circumstances. However, fairness and the law require that they treat operators doing similar things in the same way. They also require transparency in the administration of a regulatory regime, so operators will need and want to know what precedents have been created by an agency's treatment of other operators like them. All these good, well-intentioned concerns slow the review process down.

Eventually, the agency would gain experience with some of these activities and issue regulations that it could apply generally. The regulations for an activity such as operating a lunar habitat would cover how to apply for an authorization, what information needed to be provided, and would likely require demonstrations of how the applicant proposed to satisfy the agency's regulatory requirements, if, in fact, the agency offered the flexibility of performance-based regulations. The regulations would advance the interests of transparency, letting the regulated entities know what the government expected of them. At the same time, however, they would set those requirements into regulations that would take years to change through rulemaking. If a private operator wanted to do something other than what a regulation required, the operator would have to prove that it qualified for a waiver. This is also a time-consuming process.

The regulatory process balances a host of competing interests, including transparency, fairness, legal sufficiency, and safety. But, these considerations sacrifice efficiency and flexibility for private entities. As a society, we consider that sacrifice worth it when an activity jeopardizes other people. When an activity doesn't, we must ask if all these constraints are worth it. Accordingly, if Congress were to decide, as it has in the past with respect to launch, reentry, remote sensing, and satellite communications, that another space activity required regulation, it should identify that activity specifically. Space bakeries, on account of the threats posed by their ovens, might require governmental oversight if there were other people nearby. Robotic mining of asteroids millions of miles from human habitation might not.

C. The FAA's Payload Review: Threat or Opportunity?

Does the FAA's payload review authority allow the FAA to provide a positive payload determination to an entity not otherwise supervised by the federal government? Yes, it does. But, this answer may not be consistent with the view of everyone in the Executive Branch.

When conducting a payload review, the FAA must do so consistent with public health and safety, safety of property, national security, and foreign policy interests. Thus we see that the FAA's foreign policy authority allows the FAA to make its own determinations on foreign policy. Its governing statute, the Commercial Space Launch Act, requires the FAA to consult with the State Department on a matter affecting foreign policy. The FAA has implemented this requirement[2] in its regulations to state that it consults with the Department of State on foreign policy issues for its payload reviews.

Under the better and more legally sound interpretation of its authority, the FAA could use its foreign policy powers to encourage, facilitate and promote the space industry. For example, were a prospective lunar harpist to seek a payload determination from the FAA, the FAA would engage in its normal practice of inter-agency consultation. The U.S. Department of State might raise concerns with respect to the fact that Congress has not passed legislation to regulate harp playing despite Article VI's proviso that all States Parties to the treaty authorize and continuously supervise the acts of their nationals in outer space. With its own foreign policy authority, independent of that of the State Department, the FAA could determine that because Article VI is not self-executing, until Congress acts, the U.S. has not determined that playing the harp constitutes the type of activity requiring oversight

[2] The FAA could change its regulations so that it only consulted on isolated questions rather than for each payload given how 51 U.S.C. § 50918 phrases the requirement.

under the treaty. Having satisfied its consultation obligations, the FAA could then issue a favorable payload determination.

Conversely, relying on its foreign policy authority, the FAA could worry that other countries might raise issues about Article VI oversight of a lunar harpist and contemplate denying the harpist's requested payload determination. Such a determination would, however, run afoul of the fact that Congress has not determined that lunar harp playing is the kind of activity that requires federal oversight. The FAA must make any policy determinations in accordance with U.S. law, and a non-self-executing treaty is not, as noted by the Supreme Court's *Medellin* opinion, binding federal law. To treat it as such would raise the question of whether the FAA was usurping Congress's legislative role.

Lunar harp playing is a vaguely ludicrous example of an activity that could take place extra terrestrially, but it makes the point that the Outer Space Treaty left the determinations of what requires authorization and continuing supervision to each signatory nation. If Congress hasn't decided that lunar harpists or miners require oversight for their respective activities, they don't. The treaty does not say which activities must be regulated, and in the United States that determination lies with Congress. For the FAA to say that it had the ability to make such determinations about a non-self-executing treaty would be to say that it, rather than the legislative branch, could make the legislative determination.

Accordingly, because of the FAA's foreign policy authority muddying the waters over the FAA's responsibilities, the FAA's payload review creates regulatory uncertainty for industry, and likely merits closer Congressional scrutiny and possible change.

D. Most Provisions of the Outer Space Treaty only Apply to Governmental Activity in Space

If there are provisions of the treaty that the government seeks to have applied to the private sector, it should do so legislatively. The Outer Space Treaty rarely speaks of non-governmental entities, and when it does, the treaty distinguishes between a country and its nationals. The bulk of the treaty's requirements apply to "States Parties." For example, Article IV says that "States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction,..." If Congress wanted to make sure that this prohibition applied to private parties, Congress might consider implementing legislation.

Another provision that calls out for Congressional clarification—as well as a multitude of policy determinations—is whether the harmful contaminations provisions (often referred to as the "planetary protection" provisions) of Article IX apply to commercial operations. Some claim that Article VI's provision that States Parties to the treaty assure "that national activities are carried out in conformity with the provisions set forth in the present Treaty" means that commercial actors must abide today by each provision in the treaty, even the provisions that only apply to governments.

The first reason to question the applicability of the "planetary protection" provision is that the treaty itself limits this requirement, like many others, to "States Parties." States Parties are governments. When the drafters of the treaty intended a particular provision to apply to non-governmental entities they said so. For example, Article IX contains another provision that does apply to non-governmental entities, namely, the requirement for a State Party to consult with another country if it "or its nationals" might interfere with others in

outer space. Secondly, Article IX's planetary protection provision is not self-executing. It requires the legislative branch to make numerous policy judgments, such as whether the goals of space science or space settlement should preempt one another or may be pursued together.

In short, the United States did not agree to apply the harmful contamination provision to commercial operators. Accordingly, until Congress acts, we may hope that the new administration will not attempt to treat the harmful contamination provision as binding federal law for commercial operators. Just as in *Medellin* where a President could not unilaterally impose a treaty obligation on the states, regulatory agencies should not attempt to impose treaty obligations on the private sector without Congressional action.

Conclusion

In closing, I wish to say that Congress, in deciding whether to regulate a particular activity in space, should follow its usual decision-making process for deciding whether an activity requires regulation. Can the activity hurt other people? Could it have health effects? Are there national security concerns? Are there other, less burdensome solutions than federal regulation? Is it too soon to regulate? Congress has placed a moratorium on the regulation of human space flight for safety purposes. Does the same logic apply to lunar harpists? To lunar miners?

What the United States does not need to do is to regulate purely for the sake of regulation, which is what the misunderstandings over the role of Article VI in U.S. law may lead to.

Laura Montgomery
Ground Based Space Matters, LLC
Law Offices

Laura Montgomery specializes in regulatory space law, with an emphasis on commercial space transportation and the Outer Space Treaties. She focuses on the Commercial Space Launch Act, its implementing regulations governing the launch of launch vehicles, the reentry of reentry vehicles, the operation of launch and reentry sites, and the financial responsibility and liability requirements of those regulations.

Ms. Montgomery spent over two decades with the Federal Aviation Administration. She served as the manager of the Space Law Branch in the FAA's Office of the Chief Counsel. Before that, she was the FAA's Senior Attorney for Commercial Space Transportation. As the FAA's space lawyer, she supported the Office of Commercial Space Transportation in its authorization and regulation of launch, reentry, and the operation of launch and reentry sites, popularly referred to as spaceports. Her work at the FAA included legal interpretations, the development and application of regulations, legislative proposals, identification of matters for enforcement action, and legal review of licensing and permitting evaluations. Her rulemakings included human space flight, explosive siting, launch and launch site licensing and safety, experimental permits, lightning protection, and financial responsibility. She addressed a wide range of issues, from amateur rockets, to sea launch, to space balloons.

Highlights from Ms. Montgomery's time at the FAA include her representation of the FAA at the United Nation's legal subcommittee of the Committee on the Peaceful Uses of Outer Space, her service as chair to an inter-agency working group on space property rights at the request of the Office of Science and Technology Policy in the White House, and testimony to Congress on the FAA's interpretation of the Commercial Space Launch Act.

Before working for the government, she was in private practice with Arter & Hadden in Washington, DC, where she specialized in telecommunications, administrative law, and appellate work.

She received her law degree from the University of Pennsylvania, and her undergraduate degree with honors from the University of Virginia.

She has published articles on human space flight and launch safety, and blogs at GroundBasedSpaceMatters.com.

Chairman BABIN. Thank you, Ms. Montgomery.

I now recognize Dr. Dourado for five minutes to present his testimony.

TESTIMONY OF DR. ELI DOURADO,
SENIOR RESEARCH FELLOW AND DIRECTOR,
TECHNOLOGY POLICY PROGRAM,
MERCATUS CENTER, GEORGE MASON UNIVERSITY

Dr. DOURADO. Chairman Babin, Ranking Member Bera, Members of the Subcommittee, thank you for inviting me here today to participate in this timely hearing on how to promote innovation and liberty in outer space while meeting our international obligations. My name is Eli Dourado and I study the regulation of emerging technologies at the Mercatus Center at George Mason University.

Space is a domain that until now has been dominated by governments. In that respect, it is similar to the state of the internet in the 1980s. Commercial use of the internet was prohibited until 1989. Once commercial activity was allowed, the internet began to flourish and grow into the enormous economic and cultural force that it is today.

Vint Cerf, one of the fathers of the internet, credits permissionless innovation for the economic benefits the internet has generated. As an open platform, the internet allows entrepreneurs to try new business models and offer new services without seeking the approval of regulators beforehand. Because of the First Amendment and some foresighted bipartisan policies put in place in the 1990s, there's little prior restraint on the business activities that may be tried online. When harms and failures occur, we address them in an ex post manner.

My colleague Adam Thierer has generalized this notion of permissionless innovation in his book by that name. In any number of regulatory domains, there are serious, legitimate concerns that make it tempting to require innovators to seek approval before they proceed. While regulatory approval can address those concerns, it does so by dramatically slowing the pace of innovation. We must therefore build in some tolerance for mistakes, failures, and learning so that innovation can move forward. To a considerable extent, organic, bottom-up solutions will do a better job of solving these complex social problems without unduly slowing the pace of innovation.

Permissionless innovation can also be applied to space. Congress should seek to maximize the latitude the private sector has to experiment with commercial space endeavors. As with other domains, this freedom to experiment will result in some mistakes and failures. Yet over the long run, permissionless innovation will result in faster progress and more robust solutions to policy problems than a precautionary regulatory mentality.

To be sure, space is a unique domain. Space is an extremely hostile and dangerous environment, and there are clear national security interests to consider. Nevertheless, Americans have already observed the benefits of a more permissive approach to space technology, not least in the modernization of the Global Positioning System. When the Clinton Administration ended Selective Avail-

ability, giving civilian users access to the same level of granularity in GPS data as the military, numerous commentators decried the irresponsibility of the Administration's decision to allow uncontrolled access to higher-resolution location data on national security grounds. The predicted negative consequences never came to pass, and innovation flourished. Countless applications, from mixed reality to ridesharing, depend on the high-quality data this liberalization produced. Today, almost no one advocates bringing back Selective Availability. Given the closely controlled nature of space technology, further liberalizations are in order and would similarly yield higher levels of innovation.

Yet there is one recent proposed policy change that is headed in precisely the wrong direction. Last year, the previous Administration reported to Congress on a framework to regulate commercial activity in space. The Administration proposed a framework in which explicit authorization from the Secretary of Transportation would be needed for every mission, which is defined as the operation of any space object. As Ms. Montgomery has testified, this framework is unnecessary to meet our international treaty obligations. It is also exceedingly impractical and destructive. In the future that we all are working toward, humanity will establish permanent settlements in orbit and throughout the solar system. Achieving this goal will necessarily entail the operation of millions of space objects, on each occasion triggering a need for authorization from the Secretary of Transportation back on Earth. This state of affairs is unworkable and will hinder our progress into the universe.

The mission authorization framework represents the antithesis of the permissionless innovation my colleagues at the Mercatus Center and I believe is necessary for rapid technological development in space or any other domain. Instead of adopting the Obama Administration's proposal, I urge the Congress to consider blanket authorization for all nongovernmental operations in space that do not cause tangible harm to other parties, whether foreign or domestic, in their peaceful exploration and use of outer space. Such an approach would meet our treaty obligations while maximizing the scope for innovation and experimentation in space.

I thank the Subcommittee for its interest in and attention to these issues, as well as for the opportunity to testify.

[The prepared statement of Dr. Dourado follows:]

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TESTIMONY

CREATING AN ENVIRONMENT OF PERMISSIONLESS INNOVATION IN OUTER SPACE

ELI DOURADO, PhD
Director, Technolgy Policy Program, Mercatus Center at George Mason University

House Committee on Science, Space, and Technology, Subcommittee on Space
Hearing: Regulating Space: Innovation, Liberty, and International Obligations

March 8, 2017

Chairman Babin, Ranking Member Bera, and members of the subcommittee:

Thank you for inviting me here today to participate in this timely hearing on how to promote innovation and liberty in outer space while meeting our international obligations. My name is Eli Dourado, and I am a senior research fellow at the Mercatus Center at George Mason University, where I study the regulation of emerging technologies and direct Mercatus's Technology Policy Program.

THE NEED FOR PERMISSIONLESS INNOVATION IN OUTER SPACE

Space is a domain that has until now been dominated by governments. In that respect it is similar to the state of the Internet in the 1980s. Commercial use of the Internet was prohibited until 1989. Once commercial activity was allowed, the Internet began to flourish and grow into the enormous economic and cultural force that it is today.

Vint Cerf, one of the "fathers of the Internet," credits "permissionless innovation" for the economic benefits that the Internet has generated.[1] As an open platform, the Internet allows entrepreneurs to try new business models and offer new services without seeking the approval of regulators beforehand. Because of the First Amendment and some foresighted, bipartisan policies put in place in the 1990s, there is little prior restraint on the business activities that may be tried online. When harms or failures occur, we address them in an ex post manner.

1. Vinton G. Cerf, "Keep the Internet Open," *New York Times*, May 24, 2012.

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My colleague Adam Thierer has generalized this notion of permissionless innovation in his book by that name.[2] In any number of regulatory domains, there are serious, legitimate concerns that make it tempting to require innovators to seek approval before they proceed. While regulatory approval can address those concerns, it does so by dramatically slowing the pace of innovation. We must build in some tolerance for mistakes, failures, and learning so that innovation can move forward. To a considerable extent, organic, bottom-up solutions will do a better job of solving these complex social problems without unduly slowing the pace of innovation.

Permissionless innovation can also be applied to space. Congress should seek to maximize the latitude the private sector has to experiment with commercial space endeavors. As with other domains, this freedom to experiment will result in some mistakes and failures. Yet over the long run, permissionless innovation will result in faster progress and more robust solutions to policy problems than a precautionary regulatory mentality.

To be sure, space is a unique domain. Space is an extremely hostile and dangerous environment, and there are clear national security interests to consider. Nevertheless, Americans have already observed the benefits of a more permissive approach to space technology, not least in the modernization of the Global Positioning System.

When the Clinton administration ended Selective Availability, giving civilian users access to the same level of granularity in GPS data as the military, numerous commentators decried the irresponsibility of the administration's decision to allow uncontrolled access to higher-resolution location data on national security grounds.

The predicted negative consequences never came to pass, and innovation flourished. Countless applications, from mixed reality to ridesharing, depend on the high-quality data this liberalization produced. Today, almost no one advocates bringing back Selective Availability. Given the closely controlled nature of space technology, further liberalizations are in order and would similarly yield higher levels of innovation.

INDIVIDUAL MISSION AUTHORIZATION IS ANTITHETICAL TO PERMISSIONLESS INNOVATION

Yet there is one recent proposed policy change that is headed in precisely the wrong direction. Last year, the previous administration reported to Congress, pursuant to Section 108 of the Commercial Space Launch Competitiveness Act, on a framework to regulate commercial activity in space.[3] The administration proposed a framework in which explicit authorization from the Secretary of Transportation would be needed for every mission, which is defined as the operation of any space object.

As others will testify, this framework is unnecessary to meet our international treaty obligations. It is also exceedingly impractical and destructive. In the future that we all are working toward, humanity will establish permanent settlements in orbit and throughout the solar system. Achieving this goal will necessarily entail the operation of millions of space objects, on each occasion triggering a need for authorization from the Secretary of Transportation back on Earth. This state of affairs is unworkable and will hinder our progress into the universe.

The mission authorization framework represents the antithesis of the permissionless innovation my colleagues at the Mercatus Center and I believe is necessary for rapid technological development in space or any other domain. Instead of adopting the Obama administration's proposal, I urge the Congress to consider blanket authorization for all nongovernmental operations in space that do not cause tangible harm to other parties, whether foreign or domestic, in their peaceful exploration and use of outer space. Such an approach would meet our treaty obligations while maximizing the scope for innovation and experimentation in space.

CONCLUSION

I thank the subcommittee for its interest in and attention to these issues, as well as for the opportunity to testify.

2. Adam Thierer, *Permissionless Innovation: The Continuing Case for Comprehensive Technological Freedom*, rev. ed. (Arlington, VA: Mercatus Center at George Mason University, 2016).
3. John P. Holdren to Sen. John Thune and Rep. Lamar Smith, April 4, 2016, https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/csla_report_4-4-16_final.pdf.

Eli Dourado, PhD

Director of the Technology Policy Program

Mercatus Center at George Mason University

Eli Dourado is a Senior Research Fellow at the Mercatus Center at George Mason University and director of its Technology Policy Program. He has studied and written about a wide range of technology policy issues, including Internet governance, intellectual property, cybersecurity, and cryptocurrency. His current focus is on aviation innovation—commercial drones, supersonic flight, and flying cars. His popular writing has appeared in *The New York Times*, *The Wall Street Journal*, *The Washington Post*, and *Foreign Policy*, among other outlets.

Dourado is an advisor to the State Department on international telecommunication matters and has served on several U.S. delegations to UN treaty and policy conferences. He received a PhD in economics from George Mason University and a BA in economics and political science from Furman University.

Chairman BABIN. Thank you, Dr. Dourado.

I now recognize Mr. Loverro for five minutes to present his testimony.

TESTIMONY OF MR. DOUG LOVERRO,
FORMER DEPUTY ASSISTANT SECRETARY
OF DEFENSE FOR SPACE POLICY

Mr. LOVERRO. Thank you, Chairman Babin, Ranking Member Bera, and Members of the Subcommittee. I'm pleased to join Ms. Montgomery, Dr. Dourado, Mr. Burnett and Dr. Hogue to talk to you today about the issues in question surrounding the possible need to regulate the burgeoning U.S. commercial and entrepreneurial space industry.

I come before you as the former Deputy Assistant Secretary of Defense for Space Policy to provide you my view on the challenges of assuring continued U.S. leadership from primarily a national security perspective. That perspective is informed by a sure understanding that strength in national security is inextricably tied to the health and vitality of U.S. industry and that without a vibrant, innovative and bold commercial and entrepreneurial space sector, the U.S. risks falling behind pure competitors in the national security space realm. Given that by any measure, space is integral to modern war fighting, that's a risk we cannot allow to happen, so thank you for the opportunity to speak to you today.

Let me quickly explain why this is so important. Today we find that space capabilities are fully intertwined into every aspect of U.S. war fighting from the largest major force conflict down to the smallest unit-level action but threats to those capabilities are growing and are evolving at an alarming rate, representing a huge range of possible attack modes including every known form of kinetic, electronic and cyber-attack.

As we in DOD analyzed this problem over the last four years, it became clear to us that if we were to defer or defeat such attacks, we would not be able to do it solely from within the confines of U.S. military spending nor by following the development timelines associated with U.S. military procurement. There was not enough money, and the threats were evolving too quickly. Luckily, we didn't have to.

Worldwide commercial space activities today comprise nearly $280 billion enterprise and the overwhelming majority of that is from within the United States. U.S. government space spending, on the other hand, is one-sixth that amount, about $45 billion. More importantly, commercial and entrepreneurial space activities move more quickly and are innovating in every aspect of the space enterprise including mission types, manufacturing methods, terrestrial infrastructure, and orbital domains. So as we in DOD try to figure out how we would defend U.S. national security space interests against the threats we saw developing, we realized that one of the primary pillars of that defense would be built on the success of the U.S. commercial space sector. In short, our conclusion became that the U.S.—the strength of the U.S. commercial entrepreneurial space sector was a key ingredient in DOD strategy to deter aggression in space and to defeat those threats if it was ever used.

So it was against this backdrop that in my role as the lead for Defense Space Policy, I began to assess what steps DOD specifically and the U.S. government more generally needed to take to assure a vibrant, innovative and bold commercial and entrepreneurial space sector would be there when we needed it.

As I explain more fully in my written statement, in my mind, the single—the largest single threat to a thriving commercial space market we all seek to foster is the potential for lapses in spaceflight safety, which would seriously damage the entire commercial space industry. This is the key issue for us to understand. Whereas accidents in the terrestrial environment have impacts that are limited and quantifiable in economic, spatial and temporal terms, accidents in space have an unlimited temporal and physical dimension and effects that go well beyond our ability to economically quantify their impact. How can we even begin to assess the cost to U.S. national security if an errant CubeSat accidentally destroyed a U.S. national technical mean satellite? Would we just value the cost of that satellite, all the intelligence it may have collected over the rest of its expected life, or the cost to the commercial space market if we close it down for an entire year or two investigating the causes and then solutions of such an accident? And that doesn't even begin to talk about the resulting debris that would be up there for centuries.

Even worse, what if that CubeSat had been launched by a foreign power, an ally like Japan or an adversary like Russia? Would the collision be viewed as an attack? And if it were the other way around, would Russia view a U.S. satellite that hit one of theirs as an attack?

It's not my purpose here today to answer these questions. Instead, my point is to say that a laissez-faire approach to spaceflight safety has serious and non-quantifiable impacts that extend well beyond the impact to the investor, the scientist or the high school that might own the CubeSat or the COMSAT.

I'm also not saying that the only way to avoid that potential future is to emplace a set of government regulations. There are many ways to skin this cat, but rest assured, we must take some action. The space environment is becoming crowded and the potential for accidents is increasing greatly. The surest way to harm this burgeoning industry is to not provide the mechanisms to assure spaceflight safety. If we want to make sure those measures advantage rather than disadvantage U.S. industry, it is time for the United States to take the lead.

Thank you, and I look forward to your questions.

[The prepared statement of Mr. Loverro follows:]

REGULATING SPACE: INNOVATION, LIBERTY, AND INTERNATIONAL OBLIGATIONS

STATEMENT OF

MR. DOUGLAS L. LOVERRO
FORMER DEPUTY ASSISTANT SECRETARY OF DEFENSE
FOR SPACE POLICY

BEFORE THE HOUSE
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON SCIENCE

MARCH 8, 2017

NOT FOR DISTRIBUTION UNTIL RELEASED BY
THE HOUSE SCIENCE AND TECHNOLOGY COMMITTEE

REGULATING SPACE: INNOVATION, LIBERTY, AND INTERNATIONAL OBLIGATIONS

Introduction:

Chairman Babin, Ranking Member Bera, and Members of the Subcommittee, I am pleased to join Ms. Montgomery, Dr. Dourado, Mr. Burnett, and Dr. Hogue today to talk to you today about issues and questions surrounding the possible need to regulate the burgeoning US commercial and entrepreneurial space industry. I come before you today as the former Deputy Assistant Secretary of Defense (DASD) for Space Policy, to provide you my view on the challenges of assuring continued US space leadership from primarily a national security perspective. But that perspective is informed by a sure understanding that strength in national security is inextricably tied to the health and vitality of US industry and that without a vibrant, innovative, and bold commercial and entrepreneurial space sector, the US risks falling behind peer competitors in the national security space realm. Given that by any measure space is integral to a modern warfighting force, that's a risk we cannot allow to take. So, thank you for the opportunity to speak to you today.

The Role of Commercial Space in Deterring Space Attacks:

Before I dive into the specific questions surrounding the potential need to better manage our new commercial space sector, I'd like to first lay out the reasons why this question is of utmost concern to those of us from the defense-side of space. As you are well aware, for the first time since the end of the cold war, US defense-related space capabilities are threatened. And the threats we face today are far more dangerous, and far more varied than those that we faced in the last decade before the end of the cold war. Back then, well before Desert Storm, the conflict in Bosnia and Kosovo (Operation Deliberate Force), and the current fights in Afghanistan, Iraq, and

Syria, national security space was barely integrated into US warfighting save for two specific mission areas—strategic indications and warning (I&W), and nuclear conflict. Our sole adversary in the use of space for those missions was the Soviet Union, and their counterspace efforts were underdeveloped and static. Counterspace capabilities were viewed solely from a nuclear perspective and space deterrence became a subset of nuclear deterrence. Further, the commercial space industry was still nascent and dwarfed by defense-related space investments. It focused solely on satellite communications, and was managed almost exclusively by international consortia backed by nationally sanctioned organizations such as the Communications Satellite Corporation (COMSAT) in the US. All these factors taken together meant that threats to space capabilities were exclusively a problem for the DoD and would be solved by the DoD. But today, all those facts have changed.

Today we find that space capabilities are fully intertwined into every aspect of US warfighting down to the smallest unit level. And threats to those capabilities are growing and evolving at an alarming rate, representing a huge range of possible modes including every known form of kinetic, electronic, and cyber-attack. As we analyzed this problem over the last four years, it became clear that if we were to be able to deter such threat, we would not be able to do it from within the confines of US military spending nor by following the development timelines associated with US military procurement. There was not enough money, and the threats were evolving too quickly. Luckily, we did not have to.

As the Cold War ended, our nation began to develop a commercial space industry which today outspends and out-innovates government sponsored space activities by a huge margin. Worldwide, commercial space activities today comprise a nearly $280 billion enterprise, the large majority of which is based in the US. This compares to total US government space

spending of about $45B[1]. More importantly, commercial and entrepreneurial space activities are innovating in every aspect of the space enterprise including mission types, manufacturing methods, terrestrial infrastructures, and orbital domains. So, as we in DoD tried to figure out how we would defend US national security space interests against the threats that we saw developing, we realized that one of the primary pillars of that defense would be built on the success of the US commercial space sector. In short, DoD's conclusion became that the strength of the US commercial/entrepreneurial space sector was a key ingredient in the DoD's strategy to deter aggression in space and to defeat those threats if they were ever used. So, it was against this backdrop that I began to assess what steps DoD specifically, and the US government more generally, needed to take to assure that a vibrant, innovative, and bold commercial and entrepreneurial space sector would be there when we needed it.

[redacted]

DoD's conclusion became that the strength of the US commercial/ entrepreneurial space sector was a key ingredient in the DoD's strategy to deter aggression in space and to defeat those threats if they were ever used.

Threats to a Vibrant US Commercial Space Market:

Having agreed that it was in the National Security interest of the US to encourage an innovative commercial space sector, it became clear to me that the role of government in general, and the DoD in particular, was to determine what measures we needed to put in place to assure that threats to their success were eliminated. Let me explain what I mean by "threats" and "measures".

[1]Source: The Space Foundation, *The Space Report 2016: The Authoritative Guide to Global Space Activity*

Early in the US's commercial space launch journey, commercial launch firms and this committee recognized that unbounded liability for damages resulting from launch failure could have a devastating impact on that developing industry—that liability was a "threat" to growth of that industry. So, in 1988, and extended many times since then, Congress passed a Space Launch Liability Indemnification provision as part of the Commercial Space Launch Act—a government "measure" to deal with that "threat". I don't need to tell this committee that the launch liability indemnification regime has proved incredibly effective in advancing the US commercial launch industry[2].

There are similar threats with regard to space flight[3], that is the part of a space mission after launch but before reentry, that present risks to our nascent commercial space flight industry, and just as in space launch, these also call for government-sponsored measures to avoid a potential devastating impact on this critical sector. But whereas a non-regulatory indemnification approach may have been the best solution for space launch, that solution may not be appropriate for space flight. To fully understand what measures government must take, we therefore need to understand the threats and how those threats may manifest themselves.

The most prominent "threat" to commercial space flight missions is space flight safety; but space flight safety must be broken down in three distinct problems: threats to the safety of the individual commercial system, threats to the safety of other commercial and government missions, and threats to the long-term viability of the orbital environment.

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[2] See for example the Apr 2002 Study by the FAA and DoT, *Liability Risk-Sharing Regime for U.S. Commercial Space Transportation*

[3] It is difficult to derive a simple term such as "space launch" to describe the wide range of mission-types that commercial industry has either already indicated an intent to invest in (such as on-orbit servicing, or space-based commercial situational awareness), or mission types not yet considered but certainly in the realm of the possible (such a refueling). I will use the generic term "space flight" to describe the mission space for these space missions, although the reality is that the "space flight" term is only a placeholder for any activities that can be undertaken while in orbit or even deep space.

The most prominent "threat" to commercial space flight missions is space flight safety...threats to the safety of the individual commercial system, threats to the safety of other commercial and government missions, and threats to the long-term viability of the orbital environment.

The threats to the safety of the commercial system is hardly the purview of government—it is a responsibility and province solely of the owner/operator/entrepreneur and simple and straightforward economic forces will assure that any individual owner will take prudent steps based on the value of his investment, the risks he is willing to undertake, and the risk tolerance of his investment stream and customers. So government intervention is not required.

But this laisse-fare approach begins to break down as we examine the two other facets of space flight safety. In regards to the second issue, threats to the safety of other commercial and government space missions, few if any individual operators have the ability to either assess the risk their activities may pose to other space flight missions, especially US or other government missions, nor the resources or ability to ameliorate the damages their actions might have on those missions. And to ask them to try to develop those capabilities would be a greater constraint to their entrepreneurial activities than some well-designed government-sponsored measures.

...with regard to the second and third facet of space flight safety, the necessary conditions for self-regulation are absent and external action is required.

Further, since collision-caused debris in space causes a persistent, unbounded, and unknowable future harm, there is no credible way for industry to evaluate that risk. In other words, with regard to the second and third facet of space flight safety, the necessary conditions for self-regulation are absent and external action is required.

At this stage of the discussion, and before moving on to other threats, it may be helpful to examine a real-life example that illustrates this issue and the potential role for government. In 2015 an entrepreneurial space flight firm applied for a government license for a constellation of satellites that it intended to launch. The mission of that constellation was such that government approval was required, and my former office led the national security assessment of risk from that space mission. As it turned out, the primary mission function of that constellation posed no risk to US national security interests and therefore, by the letter of the law, no national security objection would have been provided.

But, in the course of our analysis, we discovered that there existed a significant risk that was not part of the statutorily envisioned process, and that risk was a space flight safety risk to other US government satellites—specifically to US national technical means (NTM) satellites and to the International Space Station, both of which together represented an investment of many tens of billions of dollars on the behalf of the US taxpayer and for which no amount of money could replace the loss to those missions if a collision occurred. In fact, we calculated that if the entrepreneurial firm launched their entire constellation into a single specific orbit, as described in their license application, there was 100% chance in the next five years that one of those small, inexpensive, and individually expendable satellites would collide with a US NTM satellite worth billions of dollars. Let me restate that finding—a 100% likelihood of collision between a commercially expendable small-sat and a major US national security asset. Faced with such a predicament, I was forced to reach beyond the statutorily envisioned assessment of national security risk, and to expand that assessment to include space flight safety. Happily, we were well-acquainted with the entrepreneurial firm and able to engage directly with their President and

CEO. Together, we arrived at very minor modifications to their licensing conditions that had zero effect on their bottom line, but virtually eliminated the collision risk we had assessed.

However, while this tale ended well, under today's existing regulatory structure, things could have gone badly. In truth, we had no legally defined authority to compel the firm to alter or adjust their plans absent the kind of national security risks originally envisioned in the licensing process. Had they been unwilling to change, we could have ended up in a circumstance where the stark reality of a 100% collision existed. And while such a collision may have had a negligible impact upon the entrepreneurial system owner, the first order impact to US national security would have been grave. Even more worrisome, the impact to all future commercial space flight endeavors would have been catastrophic because such an occurrence would have led to a near paralysis in the entrepreneurial space flight market as the inevitable investigations into "who should have been in charge" and "who was to blame" dragged on. It is not difficult to envision that a collision such as described would have shut down the entrepreneurial space flight industry for years; and all that is even before we examine the impact to the orbital environment of thousand more pieces of debris circulating in previously economically valuable orbits, or if the collision occurred between a US commercial satellite and the military satellite of another nation.

...the impact to all future commercial space flight endeavors [from a collision with an NTM satellite] would [be] catastrophic because such an occurrence would [lead] to a near paralysis in the entrepreneurial space flight market as the inevitable investigations into "who should have been in charge" and "who was to blame" dragged on.

This example presents a stark reality that reaches well beyond the specific instance cited in this case, and that reality is easily understandable—innovation in space can be constrained by many factors; financial, environmental, technical, regulatory, and others. Those constraints may be applied prospectively, as in the case of regulation, or reactively, as in the backlash from an unplanned collision. Both can harm innovation, but reactionary constraints are unbounded and uncontrollable, while prospective constraints are able to be analyzed and adjusted.

The International Dimension:

In the preceding section, I introduced the concept of "threats" to commercial/ entrepreneurial space flight focused on safety. But there is another threat that, while far less devastating, could easily put US industry and national security at a distinct disadvantage, and that is the "threat" of foreign regulatory developments. While we sit here today and discuss appropriate or necessary measures that government should take to enhance the US commercial space flight industry, similar discussions are occurring in other national and international fora on exactly the same topic. Other nations are as concerned as we are about the potential of unmanaged commercial space traffic leading to collisions in space and the long-term pollution of the space environment. And so, they are beginning the process both internally and in international bodies to try to set down a set of guidelines on flight rules and possible regulation.

On the one hand, we might be tempted to say that we can ignore any such restrictions that we do not feel are in the US interest. But such a stance would ignore the global nature of the space flight market and possible negative impact that could occur if the US were the only nation that flouted such guidelines (for example, the refusal of other nations to launch US commercial missions or to allow their nation to lease services from US firms that did not support those guidelines). Rather, as in the case of air transport regulations decades before, it behooves us to

lead in the development of guidelines that advantage the US commercial market within the global space marketplace and then to propagate those guidelines internationally. By doing so we would protect our industry from the fallout of collisions caused by other nations' space systems and from an overeager international community to regulate aspects of space flight outside US interests. Bluntly, we should seek to develop US guidelines that advantage US manufacturers and US industry rather than try to deal with guidelines others develop that are not in our interest.

Bluntly, we should seek to develop US guidelines that advantage US manufacturers and US industry rather than try to deal with guidelines others develop that are not in our interest.

Where Now:

Over the course of this paper I have examined a limited subset of the reasons why it may be to the advantage of the US commercial space flight industry to support the development of guidelines, measures, or regulations that would help avoid and limit some of the "threats" to that industry's success. And I have only scratched the surface. In my mind, the form that these guidelines take—government established regulation, industry standards, technical improvements in tracking, or a set of public-private best practices—is less important than the fact that we realize that some guidelines are required. While the ways to implement those common sense practices a can vary greatly, everywhere from strictly enforced government defined flight zones, to commercially developed aids to precision orbital tracking[4], it is clear that some measures are called for.

[4] Reducing the error in tracking active space objects by two orders of magnitude from a 5-kilometer error to a 50-meter error would virtually eliminate the uncertainty bubble around most space missions that cause the vast majority of conjunction notifications.

In 1988 this committee found it in the interest of the commercial space launch sector to provide government sponsored liability indemnification as a means to kick-start an industry that had barely begun to "lift-off" (pun intended). We are in a far more advanced stage of development in the commercial space flight sector, and our rate of innovation is increasing. If we want that innovation to continue, and to protect it from the unforeseen and uncontrollable impact of a major space collision, international regulation, or other forces, we must begin now to develop the measures necessary for their continued success.

Douglas L. Loverro

Mr. Douglas L. Loverro, is a recognized and highly sought-after expert in defense and intelligence space matters, having worked for over 30 years in the Department of Defense (DoD) and the National Reconnaissance Office (NRO) developing, managing, and establishing national policy for the full range of National Security space activities. For the last four years, he served as the Deputy Assistant Secretary of Defense for Space Policy. In this role, he was responsible for establishing policy and guidance to assure United States and allied warfighters the benefits of space capabilities and to help guide the Department's strategy for addressing space-related issues. He led Departmental activities in international space cooperation, assessment of the national security impacts of commercial space activities, and oversaw the establishment of a strategy for addressing growing challenges in space security.

From 2007 to 2013, Mr Loverro served as the Executive Director and Deputy Program Executive Officer for the Air Force Space Command's Space and Missile Systems Center (SMC). In that capacity, he was responsible for the development, deployment, and sustainment of all Department of Air Force space systems and was a key spokesman for addressing the growing importance of space systems and the steps needed to assure them for the future. Prior to his assignment at SMC, he served in a wide range of space leadership roles as Deputy Director of System Engineering at the NRO, and Program Director for the Future Imagery Architecture System, the US Global Positioning Satellite (GPS) System, and the Air Force's classified space control systems program.

Mr. Loverro is credited with a wide-ranging list of accomplishments in aerospace development including the development of a national strategy for space defense and space system resilience, initiating modernization of the third-generation GPS System, establishing the DoD's Global Broadcast Service program, and the invention of the supersonic chemical oxygen-iodine laser. He is an outspoken advocate for greater use of commercial capabilities and manufacturing for future DoD space and launch missions. He retired from active duty in the Air Force as a Colonel in February 2006 after 30 years of uniformed service and upon selection as a member of the Defense Intelligence Senior Executive Service.

Mr. Loverro holds an M.S. in Physics from the University of New Mexico, an M.S. in Political Science from Auburn University, an M.B.A. from the University of West Florida, and a B.S. in Chemistry from the United States Air Force Academy. He was the top graduate from his class at the Industrial College of the Armed Forces and is a graduate of the JFK School of Government Senior Executives in National and International Security Program, and the National Defense University's Pinnacle Program.

Mr. Loverro is married to Stephanie Loverro and they have two children, Adam and Kari. He is an avid triathlete and is in competition with his daughter, who is winning.

Chairman BABIN. Thank you, Mr. Loverro.

Now I now recognize Mr. Burnett for five minutes to present his testimony.

TESTIMONY OF MR. DENNIS J. BURNETT,
ADJUNCT PROFESSOR OF LAW,
UNIVERSITY OF NEBRASKA-LINCOLN,
COLLEGE OF LAW

Mr. BURNETT. Thank you, Mr. Chairman.

Mr. Chairman and members of the Subcommittee, I'm here to present my views about how to achieve freedom of space. To me, freedom of space is a goal to achieve maximum freedom of action balanced with restraints necessary to protect important national interests and restraints that are not arbitrary.

Now, freedom of space for governmental activities was firmly established in the Outer Space Treaty, as you mentioned in your opening statement, Mr. Chairman. However, freedom for commercial uses of space was not a foregone conclusion as it was opposed by the Soviet Union. The compromise that was reached is contained in Article VI, and you have already heard what Article VI provides.

Now, that compromise was not a difficult compromise for the United States in 1967. There was only one commercial operator of settlements. That was the Communication Satellite Corporation, or COMSAT, and COMSAT was fully regulated by the Federal Communications Commission. Now, in 1984, the FCC type of regulation was expanded to cover commercial remote sensing and commercial launch services, and it could be fairly said these comply with the requirements of Article VI.

Well, now we are on the cusp of a new era of commercial activities in outer space. We are seeing new business ideas, innovative technical developments, and the availability of funding to make these ideas possible. Imagine the innovations that will be enabled by the reduction of the cost of access to space by reusable launch vehicles.

Now, the advent of new space activities, that is, activities that are not regulated by the FCC, not regulated by NOAA and not regulated by the FAA, the advent of these new activities presents us, the nation, with an opportunity to reexamine and rethink our national approach to regulation and the opportunity to consider how to remove unnecessary barriers to realizing the benefits of new space activities.

We are here today, or I am here today to reexamine and rethink three such subjects. First, the treaty obligations. As you know, the treaty in Article VI requires a minimum of some type of authorization and supervision. I think the word "minimum" here is extremely important. Authorization needs only to be some form of official permission or approval of an activity. Supervision needs only to include some type of monitoring on a recurring basis. The treaty does not require more.

Second, the options. Congress can choose from options that range from regulatory-heavy to regulatory-light. Regulatory-heavy are the existing regulatory models. Regulatory-light could be something as simple as a registration bottle.

Third, what are the restraints necessary to protect important national interests? Now, the existing regulatory models provide, I believe, a cautionary lesson for trying to protect national security by requiring coordination and cooperation between numerous executive agencies and by requiring compliance by the applicant with unspecified national interest. Some of the decision criteria that are used are black boxes, and classification of information is sometimes used for can be used as a shield to protect against untethered discretion. The applicant must prove a negative, which is a logical impossibility, and the burden of forward never shifts from the applicant. Almost in any other circumstance such a process would be considered to be both arbitrary and capricious and lacking the fundamental balance necessary to achieve what we consider to be the standards of freedom. Freedom is not present when restraints are arbitrary.

Now, one possible solution is to establish by legislation a clear list of objective decision criteria and establish a threshold for shifting the burden of going forward. Now, some examples are provided in my written testimony. Now, the elephant in the room is classified information. However, I must say that only once in my nearly 40 years of private practice have I encountered a situation where a security requirement truly precluded the resolution of a problem.

So in conclusion, I would like to emphasize that it is in our national interest to reexamine and rethink our national approach to regulation. Our new generation of space entrepreneurs deserve freedom to innovate new technologies, new products and new ways of doing business. They deserve freedom from arbitrary restraints, and they deserve a process that can provide an authorization at the speed of business.

Thank you.

[The prepared statement of Mr. Burnett follows:]

Statement

of

Dennis J. Burnett, LL.M., J.D.

Adjunct Professor, University of Nebraska, College of Law

Chairman, Advisory Board for the Space, Cyber & Communications LL.M. Program, University of Nebraska College of Law

Chief Counsel, Government and Regulatory Affairs, Kymeta Corporation

Before the

United States House of Representatives

Committee on Science, Space and Technology

Subcommittee on Space

on

"Regulating Space: Innovation, Liberty, and International Obligations"

(March 8, 2017)

Introduction

Mr. Chairman and Members of the Subcommittee, it is my pleasure to present my views about the subject of this hearing: "*Regulating Space: Innovation, Liberty, and International Obligations.*"

I have a long-standing interest in domestic and international law relating to commercial space activities. My experience in the practice of law over the past forty-four years includes service as an attorney advisor to an independent United States regulatory commission and as both corporate in-house counsel and outside counsel to private companies that have developed or attempted to develop new and innovative commercial uses of space. I have participated in numerous space-related new business development efforts; some that have been frustrated by over-regulation and some that have been fostered by government support.

I would like to emphasize that I am here today to present my personal views and not to represent the views of the University of Nebraska-Lincoln College of Law or of the Kymeta Corporation.

The Focus of the Discussion

This testimony addresses issues related to the potential regulation of activities in outer space for which there is no existing United States regulatory authority.[1] These activities will be referred to herein for convenience as "new space" activities.

[1] Activities that already are regulated are: (a) the use of radio frequencies for communication to or from the United States (regulated by the Federal Communications Commission ("FCC")); (b) operation of remote sensing satellites (regulated by the National Oceanic and Atmospheric Administration, United States Department of Commerce ("NOAA")); and (c) the operation of a launch vehicle, operation of a launch site, reentry of a launch vehicle, operation of a reentry site (regulated by the Federal Aviation Administration, United States Department of Transportation ("FAA")).

The issues related to whether a new regulatory regime is required for new space activities are not new to Congress. The *United States Commercial Space Launch Competitiveness Act* (Public Law 114-90, hereinafter the "Act") required the Administration to develop several reports for Congress. Section 108 of the Act required the Director of the Office of Science and Technology Policy, *inter alia*, to –

> (2) Identify appropriate authorization and supervision authorities for . . . [new space activities];
>
> (3) Recommend an authorization and supervision approach that would prioritize safety, utilize existing authorities, minimize burdens to the industry, promote the United States commercial space sector, and meet the United States obligations under international treaties.

A report in response to Section 108 of the Act[2] was submitted by John P. Holdren, Director and Assistant to the President for Science and Technology in the form of a letter dated April 4, 2016 to Chairman Thune[3] and Chairman Smith.[4]

The Report noted that many space faring nations have a general licensing requirement. By way of example, the Report explained that the United Kingdom ("U.K.") has a single licensing process by the U.K. Secretary of State that includes the authority to impose license conditions to ensure conformity with its treaty obligations and to protect other public interests such as national security. No other examples were cited and no alternative means of achieving "authorization and supervision" were identified or discussed in the Report.

[2] The letter from Mr. Holdren will be referred to herein as the "Section 108 Report" or the "Report".
[3] Senator John Thune, Chairman, Senate Committee on Commerce, Science and Transportation.
[4] Representative Lamar Smith, Chairman, House Committee on Science, Space and Technology.

The Report recommended a "Mission Authorization" framework and a legislative proposal for a Mission Authorization was appended to the Report. Some of key elements of the proposed legislation would –

- Define the term "mission" as the operation of a space object in outer space;[5]
- Expand the regulatory authority of the Secretary of Transportation ("Secretary") to include the authority to grant authorizations to conduct missions in outer space if such missions are "consistent with the international obligations, foreign policy and national security interests of the United States";
- Require the Secretary to authorize missions with conditions that are deemed necessary by the Secretary, in coordination with the Secretary of Defense, the Secretary of State, the Secretary of Commerce, the NASA Administrator, the Director of National Intelligence, and other appropriate departments and agencies, to comply with United States international obligations, preservation of the foreign policy interests and national security of the United States, and protection of United States Government uses of outer space; and
- Prohibit any person subject to the jurisdiction or control of the United States from conducting a mission in outer space without an authorization from the Secretary.

It is not my purpose to analyze or critique the legislation proposed in the Report, although I would be pleased to do so. Rather, my purpose is to present my views on: (1) the international obligations of the United States to authorize and supervise new space activities of nongovernmental entities; (2) the range of options for authorizing and supervising new space

[5] It should be noted that not all activities in outer space necessarily involve the operation of a space object.

activities, other than the regulatory scheme proposed in the Report; (3) the criteria for assessing the merits of the available options if we are to be vigilant in maximizing "liberty" and "innovation"; and (4) national interests that are important to maintaining or enhancing "Freedom of Space". The following will begin with a discussion of the international obligations of the United States to regulate new space[6] activities by nongovernmental entities.

International Obligations of the United States under the

Outer Space Treaty

The principle of the "Freedom of Space" is codified in The Outer Space Treaty ("Treaty").[7] This legal principle is set forth in the Article I.

> "Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States . . ."

We need to remember that this Freedom of Space was not always a recognized principle of international law as it potentially conflicted with the sovereignty of "air space". The operation of earth orbiting satellites by the Union of Soviet Socialist Republics ("Soviet Union") and the United States in the 1950s and 1960s created state practice consistent with Freedom of Space.[8] The Treaty codified that state practice.

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[6] However, it needs to be emphasized that the Outer Space Treaty is an agreement among sovereign nations and imposes no legal requirements directly on non-governmental entities; *i.e.*, it is not self-executing.

[7] TREATY ON PRINCIPLES GOVERNING THE ACTIVITIES OF STATES IN THE EXPLORATION AND USE OF OUTER SPACE, INCLUDING THE MOON AND OTHER CELESTIAL BODIES, 205 TIAS 6347, 18 UST 2410 (signed 27 January 1967, entered into force 10 October 1967).

[8] See, R. Cargill Hall, *Chapter Two, Essay*: "*Origins of Space Policy, Eisenhower, Open Skies and Freedom of Space*, John Logsdon (ed.), EXPLORING THE UNKNOWN, *Selected Documents in the History of the U.S. Civil Space Program, Volume 1: Organizing for Exploration*, NASA History Office, 213 (1995), https://history.nasa.gov/SP-4407/vol1/chapter2-1.pdf.

The Freedom of Space for the United States and the Soviet Union (the two space powers at the time of the Treaty) was not without obligations. One such obligation that was agreed to be in the interests of all nations is contained in Article II of the Treaty.

> Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

A similar obligation that was agreed to be in the interest of all nations is contained in Article IV:

> States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner. . . The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military maneuvers on celestial bodies shall be forbidden. . . .

Other obligation on the signatories to the Treaty are stated in the following Articles:

- Article V – agreement to return astronauts, render assistance to astronauts, inform of dangers to astronauts;
- Article VIII – agreement to return space objects of other States Party to the Treaty;
- Article IX – agreement to avoid harmful contamination of Outer Space and to avoid adverse changes to the environment of the Earth by the introduction of extraterrestrial matter;
- Article IX – agreement to coordinate with other States Party to the Treaty in the event of potential harmful interference; and
- Article XII – agreement to allow visits to facilities and space objects on the Moon and other celestial bodies.

Freedom of Space for Nongovernmental Entities

Freedom of Space for activities of nongovernmental entities was not a foregone conclusion. In fact, the Soviet Union at first opposed the legitimacy of any activity by nongovernmental entities in outer space.[9] Compromise was reached when the United States agreed that nations should be responsible for ensuring that the activities of nongovernmental entities comply the Treaty and that nations have the obligation to authorize and continuously supervise the activities of their nationals.

Normally a treaty is an obligation between nations and the restraints and obligations written in the treaty are obligations only of nations. The international obligations of Nation States usually are not attributed to private entities or nationals of that state. However, the compromise reached to recognize the Freedom of Space for nongovernmental entities in Article VI of the Treaty is an exception to this general rule.

> State Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by government agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organizations.
>
> [Emphasis added.]

Article VI and its dual requirements for the United States to assure that U.S. national activities are carried out in conformity with the provisions of the Treaty and that the activities of U.S. non-

[9] "The Soviet Union, true to its communist ideology, was squarely against any private activities in most economically relevant areas of society, but certainly so in an area of such strategic concern as outer space." F.G. von der Dunk, *The Origins of Authorization: Article VI of the Outer Space Treaty and International Space Law*,(2011). *Space and Telecommunications Law Program Faculty Publications*, Paper 69, http://digitalcommons.unl.edu/spacelaw/69.

governmental entities be authorized and continuously supervised by the United States are the focus of this hearing. The requirement for authorization and continuous supervision is discussed first.

Authorization and Continuing Supervision

There appears to be little if any negotiating history that informs us of how a State must authorize and supervise activities in outer space. One of the few contemporary and authoritative accounts of the negotiation of the Outer Space Treaty, which was concluded in 1967, included the following explanation of Article VI by Paul Dembling, the then NASA General Counsel who had been a member of the United States delegation to the United Nations that negotiated the Treaty.

> Article VI of the Treaty assures that the parties cannot escape their international obligations under the treaty by virtue of the fact that activity in outer space or on celestial bodies is conducted through the medium of nongovernmental entities or international organizations. Perhaps the most important of the three sentences from the standpoint of domestic concern is the second, which states that the activities of nongovernmental entities in outer space and on celestial bodies shall require authorization and continuing supervision by the State concerned. The obvious example of activity covered by the second sentence is that of the Communications Satellite Corporation, a nongovernmental entity whose activities are authorized and regulated by United States federal agencies pursuant to federal statutes and regulations. However, while no one would doubt the need for governmental control over space activity at its present stage, the second sentence of Article VI would prohibit, as a matter of treaty obligation, strictly private, unregulated activity in outer space or on celestial bodies even at a time when such private activity becomes most common-place. Although the terms "authorization" and "continuing supervision" are open to different interpretations, it would appear that Article VI requires a certain minimum of licensing and enforced adherence to government-imposed regulations.[10]
>
> [Emphasis added.]

According to Mr. Dembling, the United States has the responsibility, as a matter of Treaty obligation, to impose a certain "minimum" authorization and continuing supervision private

[10] Paul G. Dembling and Daniel M. Arons, *The Evolution of the Outer Space Treaty*, 33 JOURNAL OF SPACE LAW AND COMMERCE, 419, 436,437 (1967).

activities of United States nationals in Outer Space. The following separately examines "minimum authorization" and "minimum continuing supervision" to determine what range of options is available to the United States.

Authorization

At least one author has noted that the United States issues licenses or authorizations in a variety of forms, including "certificate, certification, approval, license, registration, waiver, or exemption."[11]

Professor Schaefer points out that the proposition that "authorization" can take many forms is supported by the ordinary meaning of the word "authorize", which is "give official permission or approval to" or "to give official permission for something to happen."[12] Surely most, if not all, of the types of licenses, permissions or authorizations which we could conceive would meet the Treaty requirement for authorization (*i.e.*, a "certain minimum" of licensing). In summary, there are numerous options for how regulation or authorization can be implemented; *i.e.*, a license issued by an independent regulatory commission or an administration of the Executive Branch of the United States is not the only option available to meet the requirement to authorize the activities of nationals in outer space.

It is my opinion that the minimum Treaty requirement for authorization could be met by completion of a registration; *i.e.*, the authorization would be granted by operation of law when the registration is accepted as completed.

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[11] Laura Montgomery, *By the Outer Space Treaty's Own Terms, The United States Complies with Article VI of the Treaty*, (December 16, 2016); http://groundbasedspacematters.com/index.php/2016/12/17/by-the-outer-space-treatys-own-terms-the-u-s-complies-with-article-vi-of-the-treaty/#more-245.

[12] Mathew Schaefer, *The Contours of Permissionless Innovations* (2017), (manuscript available from the author). Definition from the MACMILLAN DICTIONARY.

Continuing Supervision

The Department of State has interpreted the requirement for "continuing supervision" to mean that the authorization must be "contingent" to meet the Treaty requirement for "continuing supervision". There is no "continuing supervision" if there is an "absence of a mechanism for the U.S. Government to ensure that the proposed activities . . . [will] be carried out in conformity with the Treaty."[13] Under the State Department's interpretation a simple authorization, without more, is not sufficient to meet the Treaty requirement for continuing supervision.

An analysis of the ordinary meaning of the term "supervise" appears to support this interpretation. Professor Schaefer notes the word supervise means "to monitor" and the ordinary meaning of the word "continuing" is "occurring in a cyclical or repetitious pattern".[14] Professor Schaefer summarizes the requirement of the first and second sentence of Article VI as –

> . . . some process to "give official permission or approval to" and "monitor" in some "cyclical or repetitious pattern" with at least one purpose of such process to "assure" that commercial actors are complying with [Treaty] obligations.[15]

There are numerous options for how continuous supervision can be achieved, as long as there is a cyclical or repetitious pattern.

It is my opinion that this obligation can be met with a requirement for the applicant to amend the facts stated in the application if they change, to renew the application on some basis (*e.g.*, yearly renewal), and provide the authority to suspend the authorization if the applicant makes a false statement or fails to amend or renew the authorization.

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[13] Brian J. Egan, *The Next Fifty Years of the Outer Space Treaty,* (December 7, 2016) (https://2009-2017.state.gov/s/l/releases/remarks/264961)

[14] Mathew Schaefer, *supra,* Footnote 14.

[15] Mathew Schaefer, *supra,* Footnote 14.

However, the obligation to authorize and continuously supervise may not be the only Treaty obligation. As has already been demonstrated, there also is the Treaty obligation to assure that national activities are carried out in conformity with the requirements of the Treaty.

Treaty Requirements Attributable to Non-Government Entities

If the Treaty is deconstructed, it is apparent that only a certain few of the seventeen Treaty Articles can be interpreted to contain substantive obligations of the United States.[16]

Because these obligations apply by their own terms only to nations, it may be asserted that none of them are required to be imposed on non-governmental entities as a condition of authorization. However, this interpretation does not appear to square with the plain meaning of the first sentence of Article VI.

Another interpretation is that the first sentence of Article VI requires that all the national obligations are required to be imposed on nongovernmental entities as a condition of authorization. However, this interpretation does not square with state practice. More to the point, it is not the state practice of the United States.

The U.S. has established regulatory regimes for licensing operation of a radio station in space, operating a remote sensing satellite, conducting launches, operating a launch facility or reentry of launch vehicles. These licensing regimes do not require compliance with every one of the national obligations listed in the Treaty.

The testimony of Ambassador Goldberg, former Justice of the U.S. Supreme Court and head of the U.S. delegation that negotiated the Treaty provides some clarification of this issue.[17]

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[16] *See*, text re discussion under the heading of International Obligations of United States under the Outer Space Treaty, *supra*.

[17] TREATY ON OUTER SPACE, HEARINGS BEFORE THE COMMITTEE ON FOREIGN RELATIONS UNITED STATE SENATE, Ninetieth Congress, First Session, U.S. Government Printing Office (1967), (hereinafter referred to as "Treaty Hearings").

Throughout his testimony, Ambassador made it clear that the Treaty was not self-executing in the sense that it automatically is enforceable under U.S. law. However, he also used the term "self-executing" to apply to provisions of the Treaty that are to be understood to be subject to no further conditions and no further refinements, such as Article IV and Article V. Ambassador Goldberg distinguished these provisions (Article IV and Article V) with other provisions of the Treaty that are to be understood as statements of general principles; principles that state a worthy purpose that need further study, exploration and elaboration to develop the rules to govern the use of outer space.

Following this line of reasoning, only the Treaty provisions that were understood not to be subject to further refinements should be considered as provisions that are required conditions of the authorizations required by the Treaty.

However, this Treaty interpretation does not prohibit the United States from attaching conditions to authorizations that exceed the minimum requirements of the Treaty. Furthermore, the conditions should be relevant and appropriate to the activity being authorized. Freedom of Space for nongovernmental entities is incompatible with conditions on those activities unless the conditions are relevant to the activity.

Freedom of Space and Liberty

The concepts of freedom and liberty are intertwined and the words are sometimes used as synonyms. There are many definitions of the word "liberty" but one which captures the essence of the concept is as follows:

> Freedom from restraint, under conditions essential to the equal enjoyment of the same right by others; freedom regulated by law. *Kelly v. James*, 37 S.D. 272,157 N.W. 990, 991. [18]

Note that the definition begins with an emphasis on "freedom of restraint" but follows with reminder that this freedom is not absolute and the freedom from restraint can be regulated by law to ensure the enjoyment of the same right by others or to secure an important interest of the nation.[19]

When we speak of "liberty" it is often expression of our general antipathy to arbitrary restraint and overzealous regulation. Regulation that is not necessary for the protection of the equal enjoyment of freedom or regulation that is not necessary for the protection of an important national interest is to be avoided.

Innovation

Freedom from restraint generally is associated with "innovation". However, not all freedom from restraint promotes innovation and not all restraint stifles innovation. We all

[18] Other definitions: "The absence of arbitrary restraint, not immunity from reasonable regulations and prohibitions imposed in the interest of the community." *Southern Utilities Co. v. City of Palatka*, 86 Fla. 853, 99 So. 236, 240; *Nelsens v. Tilley*, 137 Neb. 327, 289 N.S. 388, 392; *Arnold v. Board of Barber Examiners*, 45 N.M., 57, 109 P2d 779, 785. "The word "liberty" as used in the state and federal Constitution means, in a negative sense, freedom from restraint, but in a positive sense, in involves the idea of freedom secured by the imposition of restraint, and it is in this positive sense that the state, in the exercise of its policy powers, promotes the freedom of all by the imposition on particular persons of restraints which are deemed necessary for the general welfare." *Fitzsimmons v. New York State Athletic Commission*, Sup., 146 N.Y.S. 117, 121.

[19] "The absence of arbitrary restraint, not immunity from reasonable regulations and prohibitions imposed in the interest of the community." *Southern Utilities Co. v. City of Palatka*, 86 Fla. 853, 99 So. 236, 240; *Nelsens v. Tilley*, 137 Neb. 327, 289 N.S. 388, 392; *Arnold v. Board of Barber Examiners*, 45 N.M., 57, 109 P2d 779, 785. "The word "liberty" as used in the state and federal Constitution means, in a negative sense, freedom from restraint, but in a positive sense, in involves the idea of freedom secured by the imposition of restraint, and it is in this positive sense that the state, in the exercise of its policy powers, promotes the freedom of all by the imposition on particular persons of restraints which are deemed necessary for the general welfare." *Fitzsimmons v. New York State Athletic Commission*, Sup., 146 N.Y.S. 117, 121.

understand that monopolies (*i.e.*, the lack of competition) stifle innovation and that market competition promotes innovation. Restraints on monopolies clearly promote innovation.

If our national objective is to promote technical and market innovation, we should not be striving to achieve an absolute absence of restraint but instead to avoid restraint that stifles innovation. Examples of the kind of restraints that stifle innovations are –

- Restraints that impose unnecessary administrative burdens to establish or operate an enterprise;
- Restraints that reduce competition;
- Restraints that are technologically out of date;
- Restraints that impose economic regulation;
- Restraints that introduce policy or regulatory uncertainty; and
- Restraints that are not flexible; *i.e.*, do not provide for several implementation paths to achieve compliance.[20]

On the other hand, restraints that promote competition and restraints that reduce or remove policy or regulatory uncertainty could promote innovation.

The discussion of restraints on freedom of action are necessary for the protection of the equal enjoyment of freedom or are necessary for the protection of an important national interest fall into two general categories: (1) restraints on Freedom that are Treaty obligations the United States; and (2) restraints that are not required by any international obligation but which Congress determines are necessary for the protection of important United States domestic or international

[20] See, OECD, *Regulatory Reform and Innovation*, http: www.oecd.org sti inno 2102514.pdf and Luke A. Stewart, *The Impact of Regulation on Innovation in the United States: A Cross-Industry Literature Review*, Information Technology & Innovation Foundation (June 2010), http: www.itif.org files 2011-impact-regulation-innovation.pdf;

interests. We have discussed the Treaty obligations above. The following explores restraints that Congress may consider necessary for the protection of important national or international interests.

National Interests

In our discussion of freedom, we noted that freedom from restraint can be regulated by law to ensure the enjoyment of the same right by others or in the interest of the nation. Congress, in the exercise of its authority to regulate foreign commerce,[21] can impose restraints on freedom to use outer space to protect important national interests. One, if not the most important such interest is national security.

The Section 108 Report, discussed earlier, recommended that the national security interests of the United States be protected by conditioning authorizations to preserve the national security interest of the United States. Such conditions are those deemed necessary by the Secretary of Transportation

> "in coordination with the Secretary of Defense, the Secretary of State, the Secretary of Commerce, the NASA Administrator, the Director of National Intelligence, and other appropriate departments and agencies . . ."

There is a provision similar to this in the Land Remote Sensing Policy Act of 1992[22] and the Commercial Space Launch Act.[23] Are those provisions necessary to

[21] U.S. Const., Article 1, § 8.

[22] "In coordination with other appropriate United States Government Agencies, the Secretary [of Commerce] is authorized to license private sector parties to operate private remote sensing space systems for such period as the Secretary may specify and in accordance with the provisions of this subchapter." 15 USC § 5621(a)(1). "No license shall be granted by the Secretary unless the Secretary determines, in writing that the applicant will comply with the requirements of this chapter, any regulations issued pursuant to this chapter, and any applicable international obligations and national security concerns of the United States." 15 USC § 5621(b).

[23] The Secretary of Transportation may prescribe "any additional requirement necessary to protect the public health and safety, safety of property, national security interests, and foreign policy interests of the United States . . ." 51 USC § 50905(b)(2)(B).

protect the national security interests of the United States and is the process consistent with our concept of the freedom that new space entrepreneurs should enjoy?

Consider that an application for a license involving a reduction on the resolution limit of a proposed remote sensing system took three years to process because of issues of coordination. Consider that applications for systems that could sense objects in orbit also have taken more than three years to process. Consider that the commercial synthetic aperture radar market is dominated by foreign systems, largely due to the U.S. restrictions on resolution that do not apply to foreign systems.

Similar process issues are faced in the payload review process at the FAA. I have heard industry complaints that the decision criteria are "black boxes" and that national security "classification" appears to be a shield to protect "untethered discretion". Industry complains about lack of accountability, lack of transparency, lack of objective decision criteria and, of course, lack of timely decision even though there may be a deadline for action on an application[24] and even if there is a requirement for notifying Congress if the deadline is not met.[25]

[24] "The Secretary [of Commerce] shall review any application and make a determination thereon within 120 days of the receipt of such application. If final action has not occurred within such time, the Secretary shall inform the applicant of any pending issues and actions required to resolve them." 15 USC § 5621(c).

[25] "Consistent with the public health and safety, safety of property, and national security and foreign policy interests of the United States, the Secretary [of Transportation], not later than 180 days after accepting an application in accordance with criteria established pursuant to subsection (b)(2)(D), shall issue or transfer a license if the Secretary decides in writing that the applicant complies, and will continue to comply, with this chapter and regulations prescribed under this chapter. The Secretary shall inform the applicant of any pending issue and action required to resolve the issue if the Secretary has not made a decision not later than 120 days after accepting an application in accordance with criteria established pursuant to subsection (b)(2)(D). The Secretary shall transmit to the Committee on Science of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate a written notice not later than 30 days after any occurrence when the Secretary has not taken action on a license application within the deadline established by this subsection." 51 USC § 50905(a)(1).

There are two fundamental issues with the "coordination process": (1) there is an absence of clear objective criteria that results in the applicant having to prove a negative (which is a logical impossibility); and (2) because there are no clear objective criteria, the burden of proof never shifts from the applicant.

One possible solution is to establish by legislation a list of clear objective statements of the interests and a statement of the criteria for judging compliance with that interest.

For example, a criterion for judging whether a proposed activity is consistent with the national security could be whether the activity will cause the loss of life or serious injury to U.S. military or intelligence personnel. Another example is that a proposed activity is not consistent with national security if the activity will cause the failure of or serious damage to an important U.S. military or intelligence facility or operation.

There also needs to be a point in the authorization process when the burden of going forward shifts from the applicant. For example, if the applicant provides an analysis concluding that the activity will not cause the loss of life or serious injury to military or intelligence personnel and that the proposed activity will not cause failure of or serious damage to an important U.S. military or intelligence facility or operation, then it should be presumed that the activity is consistent with national security interests unless the facts upon which the conclusions are based are disproved or rebutted by the interested agency. The process also should allow for surrebuttal to account for facts unknown to the applicant until raised by the interested agency.

Important International Interests of the United States

Outer space is not the exclusive realm of the United States. Other nations and their nationals have the same right of use. Furthermore, every day there are more uses of outer space and more nations and nongovernmental entities using outer space.

Mutual recognition of the Freedom of Space is the only way to ensure the Freedom of Space for all.

Other States party to the Treaty have the same Treaty obligations as the United States, including the obligation to authorize and supervise the activities of their nationals in the use of outer space. It is in our national interests, including economic and national security interests, that other nations be held accountable for the actions of their nationals in outer space. Of course, we cannot reasonably hold other nations accountable for the actions of their nationals unless we do the same.

Conclusion

The United States and its nationals have the freedom to use and explore outer space. That freedom of use is conditioned by certain Treaty obligations to authorize and continuously supervise the outer space activities of nationals. The requirement to authorize and continuously supervise can be met in a variety of ways and can involve a process that can be neither burdensome or complicated. The tradespace for implementing the requirements of the Treaty and protecting national interests is large. A traditional licensing and regulatory regime is not the only option available to Congress. Options are available that could better promote U.S. interests in developing new space activities, developing new and innovative technologies and markets, and minimizing restrictions on freedom of space.

Dennis J. Burnett

Mr. Burnett is an attorney and business advisor with experience in commercial transactions and regulatory matters in the aerospace industry. During his career, he has served as an attorney advisor to an independent United States regulatory commission and as corporate in-house counsel and outside counsel to aerospace companies.

Mr. Burnett has participated in numerous space-related new business development efforts requiring compliance with domestic or foreign regulatory requirements. He has recognized subject matter expertise in all aspects of commercial space activities, including obtaining operating licenses, licensing exports of high-technology goods and services, and complying with US foreign ownership control or influence ("FOCI") requirements for U.S. companies holding U.S. facility security clearances.

Some highlights from Mr. Burnett's career include:

- Drafting proposed and testified before this Subcommittee on changes to U.S. patent law that enabled patenting in the U.S. of inventions made in outer space.
- Preparing and obtaining one of the first NOAA-issued licenses for a U.S. commercial remote sensing satellite system and obtaining FCC radio frequency licenses for a that remote sensing system.
- Representing the Russian Space Agency in the negotiation of the first multi-million-dollar Space Station contract with NASA, which formed the foundation for a successful twenty-year space station cooperation between Russia and the United States.
- Drafting and negotiating satellite purchase contracts.
- Drafting the model launch services agreement for an international launch service provider.
- Obtaining national security waivers from the President of the United States to allow export and launch of U.S. satellites or U.S. satellite components from China.
- Creating and implementing an export compliance and national security compliance program to qualify a foreign-owned U.S. company as a prime contractor for major U.S. Department of Defense programs.

Mr. Burnett is a member of the D.C. Bar, American Bar Association, American Institute of Aeronautics and Astronautics and is a member and Treasurer of the International Institute of Space Law. He has served three terms on the Defense Trade Advisory Group for the U.S. Department of State.

Mr. Burnett is an Adjunct Professor teaching export control and commercial space law at the University of Nebraska College of Law and is the Chairman of the Advisory Board for the UNL LL.M. Space, Cyber and Telecom Program. Mr. Burnett also is Chief Counsel, Government and Regulatory Affairs, Kymeta Corporation.

Mr. Burnett holds a B.S. in Political Science and German from Nebraska Wesleyan University, a J.D. from the University of Nebraska College of Law and an LL.M. from Georgetown University.

Chairman BABIN. Thank you, Mr. Burnett.

I now recognize Dr. Hogue for five minutes for his testimony.

TESTIMONY OF DR. HENRY B. HOGUE,
SPECIALIST IN AMERICAN NATIONAL GOVERNMENT,
CONGRESSIONAL RESEARCH SERVICE

Dr. HOGUE. Chairman Babin, Ranking Member Bera, and other distinguished Members of the Subcommittee, thank you for the opportunity to appear before you today to testify on regulatory organizational frameworks that currently exist in federal law.

My brief oral statement will summarize my written statement, which I previously submitted. This discussion is intended to inform your consideration of potential approaches to regulating space.

I will begin with a discussion of traditional frameworks in which regulatory power is delegated to federal agencies. I will then briefly discuss four regulatory models that involve quasi-governmental or non-governmental organizations.

To begin with, I'll discuss traditional regulatory frameworks. The most prominent means by which the federal government compels conduct by private entities is through a Congressional delegation of regulatory power to a federal agency. In many cases, the agency is empowered to issue rules that are consistent with this delegation and that have the force and effect of law. Such rulemaking must follow statutory procedures that provide the opportunity for public input. In other instances, Congress has given a federal agency the authority to control private conduct through the provision of individual licenses. The licensee generally is required to comply with certain conditions in order to maintain the license. That summarizes the traditional regulatory regime.

I now turn to four alternative regulatory models involving quasi-governmental or non-governmental entities. First, let me discuss government corporations. Government corporations are intended to perform a public purpose and are given corporate form to provide certain private sector-like flexibilities necessary to carry out that purpose. Each government corporation is either wholly or partially owned by the government. In some cases, government corporations engage in regulatory activities pertaining to the products or services they provide and the constituencies they serve. For example, the Federal Deposit Insurance Corporation is one such agency.

Second, I'd like to discuss non-governmental standard setting. Private standard-setting entities are voluntary organizations that develop technical specifications for various reasons such as to ensure that products from different manufacturers are compatible with each other. In many cases, federal agencies then promulgate regulations in which these standards are incorporated by reference, thus giving them the force of law. The types of organizations that get involved in standard setting include, for example, testing laboratories, professional societies, and independent committees affiliated with trade associations. Congress has mandated that federal regulators incorporate privately developed standards under certain circumstances. Sometimes this mandate has been given to specific regulators such as the Occupational Safety and Health Administration. More broadly, federal law generally requires that federal agencies use technical standards developed by such entities. This

mandate is to be carried out by consulting with and sometimes working with these standards groups.

The third regulatory model I'd like to discuss entails the establishment of federally chartered corporation with congressionally sanctioned exclusive jurisdiction over an activity in a specific quarter of American life. This kind of federally chartered organization is not considered to be part of the federal government. Congress has not vested such entities with specific statutory regulatory authority or mandates. Rather, the entity has been charged with operating in a given arena consistent with private arrangements, existing statutes, and other legal authorities. One example of this kind of mechanism is the United States Olympic Committee, established by law as a federal corporation. The USOC is empowered to exercise exclusive jurisdiction over all matters pertaining to the participation of the United States in the Olympic Games and in the Pan American Games, and over the organization of these events when occurring in the United States.

Finally, I'd like to briefly touch on a fourth model: self-regulatory organizations. These generally encompass private entities formed by members of an industry in an effort to self-regulate either because traditional governmental regulation is impractical or because the industry hopes to deter governmental regulation by demonstrating that the industry can effectively supervise itself. In some cases, the SRO is purely private with no involvement from the federal government. For example, the International Association of Antarctica Tour Operators was formed by private operators to establish procedures and guidelines for travel to the Antarctic. Association members must comply with these. The Association has been delegated no authority by the United States government. Other SROs are more significantly intertwined with the federal government. The Financial Industry Regulatory Authority, or FINRA, is one such self-regulatory body for broker dealers. FINRA was not created by federal law but federal law does require individual broker dealers to register with FINRA and comply with its rules. The Securities and Exchange Commission plays a significant role in supervising and overseeing FINRA's promulgation and enforcement of rules.

This concludes my testimony. I would be happy to respond to questions at the appropriate time.

[The prepared statement of Dr. Hogue follows:]

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TESTIMONY

Statement of

Henry B. Hogue
Specialist in American National Government

Before

Committee on Science, Space, and Technology
Subcommittee on Space
U.S. House of Representatives

Hearing on

"Regulating Space: Innovation, Liberty, and International Obligations"

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Chairman Babin, Ranking Member Bera, and other distinguished members of the subcommittee, thank you for the opportunity to appear before you today, in this hearing on regulating space, to testify on regulatory organizational frameworks that currently exist in federal law, with a focus on those organizational frameworks that involve participation by private entities.

This testimony begins with a discussion of traditional regulatory frameworks in which regulatory power is delegated, by statute, to federal government entities. Selected regulatory organizational models that involve quasi-governmental or non-governmental entities are then discussed, including government corporations, non-governmental standards-setting, non-governmental entities with a federal charter, and self-regulatory organizations. Examples of such entities are provided.[1]

Traditional Governmental Regulatory Frameworks

The most prominent means by which the federal government controls the conduct of private entities is through a congressional delegation of regulatory power to a federal agency.[2] Such delegations are often[3] accompanied by the authority to implement the delegation through rulemaking.[4] The agency, in an exercise of the power provided to it by Congress, then issues rules (pursuant to certain required procedures) that are consistent with the statutory delegation and have the force and effect of law.[5] In addition to the power to implement a statutory grant of authority through rulemaking, Congress will often provide the federal agency with the authority to enforce the agency's own regulations.[6] The agency, through enforcement actions and adjudications, may then impose penalties on members of the public for noncompliance with agency regulations.[7]

In other instances, rather than providing an agency with the authority to issue general regulations, Congress has given a federal agency the authority to control private entity conduct through the provision of individual licenses. Licenses are generally provided for a specified term, subject to renewal by the agency, and will typically require the licensee to comply with either statutorily or administratively established conditions in order to maintain the license.[8] The regulatory and licensing models are not

[1] For purposes of this testimony, quasi-governmental entities are those entities that feature characteristics of both governmental and private control, while non-governmental entities are those which, while perhaps sanctioned by the federal government in some way, are not controlled by federal authority.

[2] *See, e.g.*, Bowen v. Georgetown Univ. Hosp., 488 U.S. 204, 208 (1988) ("It is axiomatic that an administrative agency's power to promulgate legislative regulations is limited to the authority delegated by Congress.").

[3] Delegations to agencies can also be implied based on the nature and ambiguity of the statutory text. *See* Chevron U.S.A., Inc. v. Nat. Res. Def. Council, 467 U.S. 837, 844 (1984) ("Sometimes the legislative delegation to an agency on a particular question is implicit rather than explicit.").

[4] *See e.g.*, 26 U.S.C. § 7805 (providing the Secretary of the Treasury with the authority to "prescribe all needful rules and regulations ..."); 33 U.S.C. § 1607 (authorizing the promulgation of "such reasonable rules and regulations as are necessary to implement the provisions of this Act"); 42 U.S.C. § 3614a (authorizing the Secretary of Housing and Urban Development to "make rules ... to carry out this subchapter").

[5] *See* Chrysler Corp. v. Brown, 441 U.S. 281, 301 (1979) ("In order for a regulation to have the 'force and effect of law,' it must have certain substantive characteristics and be the product of certain procedural requisites.").

[6] *See, e.g.*, 8 U.S.C. § 1103 ("The Secretary of Homeland Security shall be charged with the administration and enforcement of this Act ...."); 25 U.S.C. § 282 ("The Secretary of the Interior is authorized to make and enforce such rules and regulations as may be necessary to carry out" the referenced chapter).

[7] *See, e.g.*, 15 U.S.C. § 45 (providing the Federal Trade Commission with authority to "prevent ... unfair methods of competition ... or deceptive acts or practices in or affecting commerce"); 49 U.S.C. § 20111(a)(1) (providing the Secretary of Transportation the "exclusive authority to impose and compromise a civil penalty for a violation of a railroad safety regulation prescribed or order issued by the Secretary").

[8] *See, e.g.*, 51 U.S.C. § 50904 (providing for the licensing of commercial space launch activities by the Department of Transportation).

mutually exclusive, but instead are often complementary. Congress may, for example, provide an agency with both general regulatory authority and more individualized licensing authority. For example, the Nuclear Regulatory Commission has been delegated the general authority both to issue regulations ensuring the safe operation of nuclear facilities and use of nuclear materials and to provide private entities with individual licenses to operate nuclear reactors or to possess nuclear materials.[9]

Congress may also delegate regulatory authority over a single topic to multiple agencies. In such a case, a lead agency may be provided regulatory authority that must be exercised in "consultation" with other agencies.[10] The lead agency in this arrangement is not bound by comments received through the consultation process. For example, the Administrator of the Environmental Protection Agency is required to "solicit the views" of the Secretaries of Agriculture and Health and Human Services before issuing regulations pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act.[11] In contrast, Congress may delegate authority to multiple agencies to issue rules and regulations jointly after reaching consensus. For example, various provisions of the Dodd-Frank Wall Street Reform and Consumer Protection Act require various agencies to issue joint or coordinated rules.[12]

It should be noted that even when rulemaking authority is provided to a federal agency, participation by private entities and the general public in the rulemaking process can be significant. For example, most agency rules are issued pursuant to the notice and comment rulemaking procedures established under the Administrative Procedure Act (APA).[13] These procedures require agencies to publish a proposed rule in the *Federal Register* and provide the general public with a meaningful opportunity to comment on the regulation.[14] The agency is further required to respond to significant comments it receives.[15] Thus, private parties are permitted an opportunity to participate in, and at times influence, the promulgation of federal rules by federal agencies.

Regulatory Models Involving Quasi-Governmental or Non-Governmental Entities

Government Corporations

A government corporation is an entity of the federal government established by Congress in corporate form. In general, such entities are intended to perform a public purpose and are given this form to provide the flexibility necessary to carry out that purpose.[16] They often provide a market-oriented product or service, have the power to use and reuse revenues and to own assets, are intended to produce revenue that

[9] *See* 42 U.S.C. § 2201(b) (rulemaking); 42 U.S.C. §§ 2232-2237 (licensing).

[10] *See* 40 U.S.C. § 1315(c) ("The Secretary [of Homeland Security], in consultation with the Administrator of General Services, may prescribe regulations necessary for the protection and administration of property owned or occupied by the Federal Government and persons on the property.")

[11] 7 U.S.C. § 136s.

[12] *See, e.g.*, 12 U.S.C. § 1851(b)(2) (requiring coordinated rulemaking issued by various banking regulators); 15 U.S.C. § 8302 (requiring joint rulemaking issued by Commodity Futures Trading Commission and the Securities and Exchange Commission).

[13] 5 U.S.C. § 553.

[14] *Id.* § 553(b)-(c).

[15] *See* Portland Cement Ass'n v. Ruckelshaus, 486 F.2d 375, 394 (D.C. Cir, 1973) ("[C]omments must be significant enough to step over a threshold requirement of materiality before any lack of agency response or consideration becomes of concern.").

[16] For a broader discussion of government corporations see CRS Report RL30365, *Federal Government Corporations: An Overview*, by Kevin Kosar.

meets or approximates their expenditures, and have the power to sue and be sued.[17] Each government corporation is either wholly owned by the government or of mixed ownership.

In some cases, government corporations engage in regulatory activities pertaining to the products or services they provide and the constituencies they serve. One example of a mixed ownership government corporation that operates in this manner is the Federal Deposit Insurance Corporation (FDIC).[18] Mixed ownership means that the corporation is owned both by the government and other parties. The FDIC insures bank and thrift deposits, examines state-chartered commercial and savings banks that are not members of the Federal Reserve System, and disposes of the assets and liabilities of failed banks.[19] In the course of carrying out these responsibilities, the FDIC exercises significant authority over certain private sector activities. It

> approves or disapproves of mergers, consolidations, and acquisitions ...; approves or disapproves of proposals by banks to establish and operate a new branch, close an existing branch, or move its main office from one location to another; and approves or disapproves of requests to engage as principal in activities and investments that are not permissible for a national bank.[20]

Over time, the FDIC has promulgated a number of regulations related to these functions.[21]

Non-Governmental Standards Setting

Federal agencies may incorporate standards developed by non-governmental entities, thereby forming a quasi-governmental regulatory mechanism. Private standard-setting entities establish voluntary consensus standards through an established process that seeks to give voice to divergent viewpoints.[22] In many cases, federal agencies then promulgate regulations in which these standards are incorporated by reference.[23] The standards set by these private entities generally lack the force of law until implemented by a government actor. The types of non-governmental organizations that get involved in standard-setting include testing laboratories (e.g., Underwriters' Laboratories), professional societies (e.g., American Society for Mechanical Engineers), membership organizations (e.g., American Society for Testing and Materials), and independent committees affiliated with trade associations or other sector-specific organizations.[24]

Congress has mandated the practice, by federal regulators, of incorporating privately developed standards under certain circumstances, both with regard to specific agencies and more generally. One example of an

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[17] *See, e.g.*, 16 U.S.C. § 831c(b) (providing that the Tennessee Valley Authority may "sue and be sued in its corporate name."); 22 U.S.C. § 2199(d) (providing that the Overseas Private Investment Corporation is authorized "to sue and be sued in its corporate name.").

[18] 31 U.S.C. § 9101(2)(B) (defining the FDIC as a "mixed-ownership Government corporation" rather than a "wholly owned Government corporation").

[19] OFFICE OF THE FED. REGISTER, UNITED STATES GOVERNMENT MANUAL 360 (2013) ("Federal Deposit Insurance Corporation").

[20] *Id.*

[21] *See* 12 C.F.R. Parts 323-391 (FDIC Regulations and Statements of General Policy).

[22] A standard setting organization is a "voluntary membership organizations whose participants develop 'technical specifications to ensure that products from different manufacturers are compatible with each other,' address certain threshold safety concerns, or serve other beneficial functions." SD3, LLC v. Black & Decker Inc., 801 F.3d 412, 435 (4th Cir. 2015). For a discussion of agency adoption of privately developed standards see Jody Freeman, *The Private Role in Public Governance*, 75 N.Y.U. L. REV. 543, 638-43 (2000).

[23] *See, e.g.*, 6 C.F.R. § 37.19 (incorporating a standard by reference for the machine readable portion of the REAL ID driver's license or identification card); 7 C.F.R. § 1755.505(f)(6) (incorporating the ANSI/NFPA 70-1999, NEC® standard by reference).

[24] *See* Robert W. Hamilton, *Prospects for the Nongovernmental Development of Regulatory Standards*, 32 AM. U. L. REV. 455, 461 (1983).

agency-specific mandate to use voluntary consensus standards pertains to the Occupational Safety and Health Administration (OSHA) at the Department of Labor. OSHA's enabling legislation provides that:

> the Secretary [of Labor] shall ... by rule promulgate as an occupational safety or health standard any national consensus standard, and any established Federal standard, unless he determines that the promulgation of such a standard would not result in improved safety or health for specifically designated employees. In the event of conflict among any such standards, the Secretary shall promulgate the standard which assures the greatest protection of the safety or health of the affected employees.[25]

Another law speaks to the issue more generally. Section 12(d) of the National Technology Transfer and Advancement Act,[26] as amended, provides that "all Federal agencies and departments shall use technical standards that are developed or adopted by voluntary consensus standards bodies, using such technical standards as a means to carry out policy objectives or activities determined by the agencies and departments."[27] In order to do so, they shall "consult with voluntary, private sector, consensus standards bodies and shall, when such participation is in the public interest and is compatible with agency and departmental missions, authorities, priorities, and budget resources, participate with such bodies in the development of technical standards."[28] The law provides for an exception if compliance is "inconsistent with applicable law or otherwise impractical."[29]

Standard-setting and standard adoption practices are the subject of guidance from both governmental and nongovernmental authorities. The Office of Management and Budget (OMB) provides guidance to executive branch agencies in this area through OMB Circular A-119, "Federal Participation in the Development and Use of Voluntary Consensus Standards and Conformity Assessment Activities," which address applicable statutes, executive orders, and other relevant authorities.[30] On the nongovernmental side, the American National Standards Institute (ANSI), a private not-for-profit organization, serves as "administrator and coordinator of the United States private sector voluntary standardization system."[31] It does this by accrediting the procedures of standards-developing organizations.

Non-Governmental Entity with a Federal Charter

Another quasi-governmental model entails the establishment of a federally chartered corporation with congressionally sanctioned, exclusive jurisdiction over activity in a specific quarter of American life. In general, whereas the government corporations discussed above generally are viewed as entities of the federal government, the federally chartered organizations discussed here are not. In contrast to regulation through a government corporation, Congress generally does not vest federally chartered organizations with specific statutory regulatory authorities or mandates. Rather, the entity has been charged with

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[25] The Occupational Safety and Health Act of 1970, Pub. L. No. 91-596, § 6, 84 Stat. 1593.

[26] Pub. L. No. 104-113, 110 Stat. 783 (1996) (codified as amended at 15 U.S.C. § 272 note).

[27] Technical standards are "performance-based or design-specific technical specifications and related management systems practices." Pub. L. No. 104-113, § 12(d)(5), 110 Stat. 783 (1996) (codified as amended at 15 U.S.C. § 272 note.).

[28] Id. at § 12(d)(2).

[29] In such a case "a Federal agency or department may elect to use technical standards that are not developed or adopted by voluntary consensus standards bodies if the head of each such agency or department transmits to the Office of Management and Budget an explanation of the reasons for using such standards." Pub. L. No. 104-113, § 12(d)(3), as amended. (Codified as amended at 15 U.S.C. § 272 note.).

[30] U.S. EXEC. OFFICE OF THE PRESIDENT, OFFICE OF MGMT. AND BUDGET, *OMB Circular A-119, Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities*, available at https://www.whitehouse.gov/sites/default/files/omb/inforeg/revised_circular_a-119_as_of_1_22.pdf.

[31] *See Introduction to ANSI*, ANSI, https://ansi.org/about_ansi/introduction/introduction.aspx?menuid=1 (last visited Nov. 9, 2016).

operating in the given arena consistent with private arrangements, existing statutes, and other legal authorities.

One notable example of this kind of mechanism is the United States Olympic Committee (USOC), which is a federally chartered corporation with circumscribed jurisdiction. In 1950, an existing organization, the United States Olympic Association, was established by law as a federal corporation.[32] Among other effects, this charter empowered the organization "to exercise exclusive jurisdiction, either directly or through its constituent members or committees, over all matters pertaining to the participation of the United States in the Olympic Games and in the Pan-American Games, including the representation of the United States in such games, and over the organization of the Olympic Games and the Pan-American Games when celebrated in the United States."[33]

As amended and codified, the organization's enabling statute arguably broadens the scope of its reach by authorizing it to recognize subordinate entities that govern particular sports. It states, "[f]or any sport which is included on the program of the Olympic Games, the Paralympic Games, or the Pan-American Games, the corporation [USOC] is authorized to recognize as a national governing body ... or as a paralympic sports organization ... an amateur sports organization which files an application and is eligible for such recognition."[34]

The history of the United States Anti-Doping Agency (USADA) illustrates a different path by which an organization and its authority over private actors might be statutorily recognized. USADA was created in 2000 "as a result of the recommendations made by the United States Olympic Committee's Select Task Force on Externalization in order to bring credibility and independence to the anti-doping [efforts] in the U.S."[35] In 2006, a provision of the Office of National Drug Control Policy Reauthorization Act established that the USADA was designated as "the independent anti-doping organization for the amateur athletic competitions recognized by the United States Olympic Committee."[36]

Self-Regulatory Organizations

A self-regulatory organization (SRO) is another regulatory model that is characterized by significant private involvement. Although there is no formal definition of what constitutes an SRO, these organizations are generally viewed as private entities formed by members of an industry in an effort to "self-regulate," either because traditional governmental regulation is impractical or because the industry wishes to deter governmental regulation by demonstrating that the industry can effectively supervise itself.[37]

SROs generally take two forms: either the organization is truly private, with no involvement from the federal government, or the SRO is imbued with some federal powers and maintains a relationship with the government, generally through a supervising agency. An example of a purely private SRO is the International Association of Antarctica Tour Operators (IAATO).[38] That organization was formed in 1991 by private tour operators as a means of ensuring safe and environmentally appropriate travel to the

[32] Pub. L. No. 81-805, 64 Stat. 899 (1950) (codified as amended at 36 U.S.C. §§ 220501-220529).

[33] *Id.* at § 3(3). This statute, as amended and codified, now also includes such jurisdiction with regard to Paralympic Games. *See* 36 U.S.C. § 220503(3)-(4).

[34] 36 U.S.C. § 220521(a).

[35] *Independence and History*, U.S. ANTI-DOPING AGENCY available at http://www.usada.org/about/independence-history/ (last visited Nov. 9, 2016).

[36] Pub. L. No. 109-469, title VII, 120 Stat. 3533 (2006).

[37] For a broader discussion of the role of SROs *see*, Freeman, *supra* note 22, at 644-52.

[38] *What is IIATO?*, INT'L ASS'N OF ANTARCTICA TOUR OPERATORS, http://iaato.org/what-is-iaato (last visited Nov. 9, 2016).

Antarctic. Members of the organization, which currently includes all companies providing commercial passenger vessel tours of the Antarctic, must "meet all of the association's standard operating procedures and established procedures and guidelines designed to promote safe and responsible operations in Antarctica."[39] Membership in the organization is voluntary, and the IAATO has been delegated no governmental authority by the United States government.

Other SROs are more significantly intertwined with the federal government. The Financial Industry Regulatory Authority (FINRA), the self-regulatory body for broker-dealers, is such an example.[40] FINRA was not created by federal law, but federal law does require individual broker-dealers to register with FINRA and comply with its rules.[41] The Securities and Exchange Commission (SEC), however, plays a significant role in supervising and overseeing FINRA's promulgation and enforcement of rules.[42] For example the agency may "abrogate, add to, and delete from" any FINRA rule and can "relieve" the organization of its enforcement powers.[43] Thus, although FINRA has effectively been provided with regulatory and enforcement authority, the SRO exercises those powers under the supervision of the SEC.[44]

This concludes my statement for this hearing on regulating space, in which I testified on regulatory organizational frameworks that currently exist in federal law, with a focus on those organizational frameworks that involve participation by private entities. I will respond to any questions you might have at the appropriate time.

[39] *Frequently Asked Questions*, INT'L ASS'N OF ANTARCTICA TOUR OPERATORS, http://iaato.org/frequently-asked-questions (last visited Nov. 9, 2016).

[40] *About FINRA*, FIN. INDUS. REGULATORY AUTH., http://www.finra.org/about (last visited Nov. 9, 2016).

[41] 15 U.S.C. § 780(b)(8).

[42] *Id.* § 78o.

[43] *Id.* § 78s.

[44] *See* Sorrell v. SEC, 679 F.2d 1323 (9th Cir. 1982) (rejecting claim that delegation to National Association of Securities Dealers (FINRA predecessor) was unconstitutional).

Henry Hogue Testimony: Professional Biography

Henry Hogue is a specialist in American national government at the Congressional Research Service (CRS). He began his work with CRS in 1999, and he has conducted research in federal government organization and reorganization, the presidential appointments process, and the practices surrounding presidential recess appointments. He earned his Ph.D. in the field of public administration from American University in 2001.

Chairman BABIN. Thank you, Dr. Hogue.

I want to thank all the witnesses for your testimony. We're looking forward to hearing your comments and your answers. The Chair now recognizes himself for five minutes.

First, Ms. Montgomery, does authorization and supervision mean federal agency regulation?

Ms. MONTGOMERY. It usually does. As we heard from the Congressional Research Service, it doesn't have to. I think that if we were to follow the Mercatus suggestion of a blanket authorization, that would sort of codify the current state of affairs, which is that if it's not forbidden for you to do something, you can go do it, but I think the question of continuing supervision gets a little trickier because someone does have to go look at somebody and what they're doing and inspect them or monitor them in some way, so I'm not sure the blanket authorization gets us all the way there.

Chairman BABIN. I understand. And one other for you, Ms. Montgomery. One concern I hear from stakeholders of non-traditional space activities is that they lack regulatory certainty. They fear that the government will inhibit some aspect of their operations, and wanting certainty and wanting regulation are two different things. How do you recommend that Congress or the Executive Branch put to rest these questions and these uncertainties?

Ms. MONTGOMERY. Well, I think a lot of the uncertainty arises out of the mistaken view that Article VI prohibits private activities in space unless they are authorized. I've heard this from people in industry, from private practitioners of the law, and it is not correct. The treaty doesn't say that, and it is not necessary that you get authorized. One way of looking at it is that we have space tourism now. It is not subject to authorization or continuing supervision and yet no one is concerned, and yet it is an activity, so everyone should rely on the fact that the treaty is not self-executing and get on with their business.

Chairman BABIN. Thank you.

Dr. Dourado, in order to satisfy Article VI authorization and supervision obligations, the Obama Administration proposed the Department of Transportation have regulatory authority to ensure consistency with international obligations, foreign policy and national security interests of the United States. This is an extremely broad grant of authority. What is the risk of such a broad grant of authority and how else could Congress or the Executive Branch address Article VI obligations?

Dr. DOURADO. Thank you, Mr. Chairman. I think you're absolutely correct, this is a very broad grant of authority, and the only way to meet all of those criteria would be for the Department of Transportation to consult widely with the interagency. That will introduce a lot of friction, and I think that's the number one risk, that it's going to just slow down the process to such an extent that innovation cannot proceed. I think another very serious risk is nontransparency as Mr. Burnett testified that some of these rulings will be a black box. There's no time limit on getting a response in the section 108 report.

So I think the broader risk is that companies that want to engage in space activities will go abroad. They will seek flags of convenience as they have done in maritime law, and they will put in-

vestment in other countries instead of the United States in order to establish a genuine link with those countries that offer that service.

So I think that blanket authorization, as Ms. Montgomery said, would codify the current state of affairs. This Committee would be, you know, well advised to hold periodic, perhaps annual hearings reviewing the state of commercial space as part of its continuing supervision.

Chairman BABIN. Thank you. Thank you very much.

One more. To my knowledge, no state has ever lodged a complaint that the United States is in violation of Article VI obligations. We've had a U.S. company successfully receive payload approval for lunar missions. What exactly is the Article VI problem that Congress is being asked to fix, and is this an issue that could easily be fixed by the Trump Administration taking executive action? And I'm directing this to you, Ms. Montgomery.

Ms. MONTGOMERY. I am not personally familiar with how easy it is to prepare an Executive Order but I do think the Administration could direct the federal agencies under it to comply with the law regarding self-executing treaties and tell them not to deny a license or payload determination or attempt to regulate outside of their authority on the basis of existing Supreme Court case law on non-self-executing treaties.

One caveat is, I'm not sure that the Executive Orders apply to independent agencies such as the FCC so I see that as a possible hurdle. The other option is, each of these regulatory agencies could issue a legal policy statement quieting the concerns of industry that things will be stopped on the basis of Article VI. The 108 report itself is clearly based on this mistaken assumption that it is—that Article VI stops private activity, and also it is based on another mistaken assumption that all of the Outer Space Treaty applies to all private activities. In fact, it does not. Where the treaty wants to make sure that something applies to private actors, it calls them out by name. It refers to, you know, the acts of the nationals or non-governmental entities but it only does that in a couple places. So it is important to realize that the 108 report with mission authorization in it is based on two very flawed premises and it should not be adopted.

Chairman BABIN. Okay. Thank you so much. I've expended my time, and I'd like to recognize Mr. Bera at this point.

Mr. BERA. Thank you, Mr. Chairman.

I think one of the dangers just kind of listening to the opening statements is regulations are not inherently good or inherently bad, right? When done appropriately, they provide guidance and they provide some clarity, and I would imagine from the commercial sector, you really do want some of that guidance and clarity not to the extent that you stifle that innovation but you have an understanding of what the rules of the road are, and that really should be what our goal is, is providing that guidance but at the same time anticipating the challenges that might occur. An example would be, you know, I think, Mr. Loverro, you brought up is what does happen, you know, who's liable if a commercial entity launches a CubeSat and it smashes into another state's, you know, let's say a Chinese satellite or vice versa into one of our satellites.

What's the liability there? If we give blanket authorization as the United States, are we held liable for that? Again, there's no inherent problem in trying to anticipate potential challenges and provide guidance and clarity.

I do have some concerns, when we talk about this blanket authorization, I think, Ms. Montgomery, you talked about if we were able to do that, well, then if you can do something, you can go do it, but again, I worry about if you go do that and something bad happens, that's not good for the commercial sector because if an accident like that happens, that could stifle commercial innovation as well, especially if there's a big liability risk.

I guess I'd ask Mr. Loverro a question. If our goal is to try to get that right guidance and anticipate the challenges without stifling the innovation, we ought to be able to do that and, maybe you can give us some guidance here and then maybe Mr. Burnett also.

Mr. LOVERRO. Thank you, sir.

Let me first say that if the purpose of this hearing is to figure out if the Outer Space Treaty mandates us do some authorization, I think we're looking in the wrong spot. I'm in full agreement with Ms. Montgomery and Dr. Dourado that that shouldn't be the basis for why we go ahead and regulate. We need to regulate for the good of America and for the good of American business and for the good of American national security, and I use the word "regulation" but I don't necessarily mean regulation in the narrow sense but more in a sense that Dr. Hogue has already introduced.

We need to make sure that space is safe for commercial expansion, that space is a safe place for the United States to go ahead and achieve economic superiority and to maintain national security. Safety in space is unlikely safety in any other domain. Collisions at sea sink to the bottom of the sea. That doesn't happen in space. Things in the air fall to Earth. That doesn't happen in space. They are limited in time and they're limited in dimension. That does not happen in space.

The piece of the first collision that happened ever in space are going to be up there for the next thousand years, so we have to be very cognizant of the fact that there are some rules that need to be created in order to go ahead and protect U.S. space activity, whether national security activity or economic activity, and quite frankly, not just from our own commercial sector but the commercial sectors of other nations that might have less control than we could have.

And the last thing that I would like to see happen is for other nations to develop rules that we then become forced to follow. That is not good for our industry. We need to lead. We need to develop rules that are right for the United States, and then we need to convince the rest of the world that those rules are the ones they should follow. That's what we did in aviation and the FAA. We created the rules, and then everybody else followed. That's where we need to be because there's too great of a risk to our commercial endeavors and too great of a risk to our national security endeavors if we don't do that.

Mr. BERA. Great.

Mr. Burnett, if you want to just expand on that?

Mr. BURNETT. Yes, I really agree with Mr. Loverro about that. I think there's some really good reasons for having some form of authorization and supervision. One of them is industry, when they go to their regulator—excuse me—when they go to their financers, when they go to their insurance brokers, those people want some form of government authorization that they can rely on. Internationally, we want to be able to hold other nations to the same standards that we apply. And furthermore, the foreign commerce that's going to be developed here requires our industries, our new space industries, to engage in foreign trade with foreign nations, and if those nations have the impression that the United States is not living up to its obligation under the treaty, there could be serious trade problems.

Mr. BERA. I'm about out of time, or I am out of time, but I would hope that on this Subcommittee we could start addressing some of those issues and find that right middle ground where we're not overburdensome but we also provide some clarity to the commercial sector, which will allow the commercial sector to thrive, and you know, let's write the rules as the United States.

Chairman BABIN. Thank you, Mr. Bera.

The gentleman from California, Mr. Rohrabacher.

Mr. ROHRABACHER. Thank you very much, Mr. Chairman, and I would like to thank you, Mr. Chairman, for organizing this hearing. This is a level of discussion that we need to have before we actually move forward with litigation—or legislation, which brings litigation. Let me note that Dr. Dourado, you said something right off the bat and made a comparison which I think was very mind-expanding, for me anyway. You were comparing the internet to what we're doing in outer space. So we're comparing the science that we've achieved for very tiny, small things, we're comparing that same science to the expansion of the universe, which they told me in astronomy that we were learning secrets up there that apply to molecular structures here. It's a fascinating sort of insight into the way the world works.

I have noticed that over the years as I have been trying to figure out how the world works that government bureaucratic regulation is actually the most efficient method known to man for turning pure energy into solid waste. So that's one truism that we have to deal with when we're looking at this. We don't want to regulate and protect us to the point that we're not able to do anything in space, and I believe that had the internet been structured and we were permitted to tax the internet right off the bat, we would have taxed it into oblivion and regulated it into oblivion.

Yet we do know that libel laws and fraud laws are in force even though they're over the internet. So there's a relationship there that we need to establish that's a practical relationship but with understanding the concept that we've got something new; let's go get the most out of it but not throw away every aspect of regulation that we talk about because liabilities like libel and fraud are indeed part of our whole legal system.

Let me just note that Mr. Loverro, you described the scenario where a satellite or some object that we put into space or someone else actually destroyed somebody else's space asset. I think this is a real problem, and it's called space debris, and I think what we're

discussing today, Mr. Chairman, is a treaty that was actually brought about and negotiated and agreed upon at the height of the Cold War, at the very height of the Cold War when I was in a place being shot at in 1967 by Russian bullets, all right? And the bottom line is that if we can do that in 1967, to try to further space cooperation, we could do that today, and what we're talking about is not a need for necessarily more regulation but maybe a methodology where we can have more cooperation with people who are engaged in space activities, and if we could work with the Russians when they were the Soviet Union, we should certainly expand upon that today to handle exactly the same target that you're talking about, space debris, so that nothing that we are doing in space or legalizing our private sector to do in space will in some way inhibit other people and future generations to utilize space, and space debris is something I would suggest that, Mr. Chairman, this Subcommittee focus on and see if we can come up with some cooperative effort internationally to deal with that very same issue, and now you've got 30 seconds to say you're brilliant or you really don't know what you're talking about. So maybe we'll start down here with just a comment. Any comment on——

Ms. MONTGOMERY. I do think the liability issue is an interesting one that you mentioned in the litigation context but I don't think it legally mandates the United States to regulate everything.

Mr. ROHRABACHER. Right.

Dr. DOURADO. Mr. Rohrabacher, I totally agree with your assessment that just because we don't have to regulate something in advance doesn't mean that there are no regulatory mechanisms ex post, and I think it's very important to keep that distinction, and that is the distinction I have in mind and my colleagues have in mind when we talk about permissionless innovation and the ability to do something without ex ante approval doesn't mean that you can just get away with absolutely everything.

Mr. LOVERRO. Sir, our time's over so I'll keep it short. You're brilliant.

Mr. ROHRABACHER. You're invited back.

Mr. BURNETT. I'm not going to follow that.

Chairman BABIN. All right. Time's expired. Thank you, Mr. Rohrabacher.

Now the gentleman from Virginia, Mr. Beyer.

Mr. BEYER. Well, I want to begin, Mr. Chairman Babin, Ranking Member Bera, thank you for doing this. This is fascinating, although I have to take issue with Mr. Loverro encouraging Mr. Rohrabacher.

Dr. Dourado, I'm fascinated by this whole idea of permissionless innovation, and if I sort of think back through the history of innovation, whether it's Marconi or Bell or Edison or the internet or on and on and on, most of that seems to have been permissionless, although I do worry, number one, we have all this CRISPR X genetic technology now, especially on germ cells, and worry about what permissionless innovation might do there, and then I think Mr. Loverro in his written and verbal testimony spoke very clearly about the one issue that came to him as a Deputy Assistant Secretary of Defense about the collision caused debris in space and that one case, they had a 100 percent likelihood of a collision be-

tween a commercially expendable small satellite and a major U.S. national security asset. When we can see ahead of time that there're going to be real problems with space debris, as Mr. Rohrabacher said, doesn't that handcuff us a little bit on permissionless innovation? Don't we have to—can we not recognize that not everything can be addressed after damage has been done?

Dr. DOURADO. Thank you, Congressman. I agree with you that CRISPR is a fascinating technology and I think that permissionless innovation is where we will end up with that because it is so hard to regulate. It is something now that can be done in a garage by someone with minimal training, and I think it will have major, major benefits for the world and also some very serious challenges that even make me uncomfortable but I think that we will adapt and it's that process of adapting after the fact that is critical to permissionless innovation in any domain from CRISPR to space.

Mr. BEYER. As long as we can recognize ahead of time that there may be places where we can see a challenge coming.

Mr. Loverro?

Mr. LOVERRO. Yes, sir. Thank you very much. And I'm sorry for encouraging Mr. Rohrabacher. I'll try not to do that in the future.

So, you know, I very much want to be where Dr. Dourado is, to say that everything should be permissionless, but that's just not the way the world can work. There are some things that absolutely need to go ahead and have rules drawn around them. We see this all the time. I was sharing with Mr. Bera before the testimony began about what the state of affairs driving around San Francisco looked like in 1906 before there was any traffic laws, and it was pandemonium, and that was fine when cars were only going 5 miles an hour but if you really wanted to create cars that could go 60 miles an hour, you needed some set of rules to say which side of the road you needed to be on in order to go ahead and do that. We couldn't have gone 60 miles an hour without a set of rules that said what side of the road to be on.

The example that you stated clearly was a significant national security concern. We had a license in front of us under what I think is, and I agree with Mr. Burnett is an overstrenuous regime in remote sensing but we had a license in front of us, remote sensing under the current rules, that had no problem with remote sensing but clearly was going to go ahead and have an incredibly deleterious impact on a U.S. national security satellite without question.

I quite frankly in front of this Committee I say I overstepped my authority and I went to work with that form to ask them to adjust their orbit, and they did because they're concerned American citizens as well. But if they had chosen not do that, I would have lost that case in court and we would've had the potential that those settlements were lost.

Somebody needs to be able to have that discussion. It doesn't necessarily need to be a bureaucrat from the Department of Defense. It doesn't necessarily need to be somebody in the Department of Transportation but somebody needs to be able to just have the discussion of which side of the orbit are we flying and how do we go ahead and make sure that we're doing this to the benefit of

all, and we want to have that happen before the accident occurs because while we can legislate after, we can't clean up after.

Mr. BEYER. Very quickly, Dr. Dourado also talked about relaxing the access to the granularity of GPS data, and now it's given rise to Uber, et cetera. I talked to somebody recently, I think it was a geographer at the University of Maryland who said there's yet another level of granularity that would open up many new industries, and I don't remember whether it was from 5 meters to 1 meter or 3 meters to 2 inches but do you have any comment from a defense perspective?

Mr. LOVERRO. Certainly. I was a huge advocate on the DOD side to go ahead and loosen all restrictions on imaging. The rest of the world's going to do it anyway. We might as well be in the lead. It made no sense. While there may have been some time in the past where it made sense, it made no sense, and quite frankly, at the very end of the last Administration, I convinced the intelligence community of that very thing, and so we're hopefully on our way to do that.

Mr. BEYER. Thank you very much.

Thank you, Mr. Chairman.

Chairman BABIN. Yes, sir. Thank you, Mr. Beyer.

Our next questioner is the gentleman from Oklahoma, Mr. Bridenstine.

Mr. BRIDENSTINE. Thank you, Mr. Chairman.

I wanted to see if I could get consensus with you, Mr. Burnett and Ms. Montgomery, because I think there's maybe some inconsistencies regarding the self-executing concept that Ms. Montgomery I think brought up, which I think is really important.

You mentioned that we do have to provide authorization and continuing supervision although it can be very minimal, which I think would be of course appropriate. She mentioned that for these nontraditional space activities, habitats, rendezvous and proximity operations for maybe orbital servicing or maneuvering satellites, station keeping, she suggested that maybe we don't have to do anything under the Outer Space Treaty because it's not self-executing, that authorization and continuing supervision is sufficiently ambiguous that makes bodies like this have to act, and since we haven't acted, we don't have to regulate those programs. Is that correct?

Mr. BURNETT. This is an extremely complicated subject.

Mr. BRIDENSTINE. Sorry.

Mr. BURNETT. I mean, I've heard discussions by legal scholars that are totally confusing but I think here what we're talking about and the difference between what Laura and I are talking about is I'm talking about the obligation under international law that the United States government has.

Mr. BRIDENSTINE. So that might not be a treaty, it could just be norms of behavior that have been established over time?

Mr. BURNETT. It could be, but in this case, it is in the treaty in Article VI. That's an obligation of the United States. That is not an obligation on private actors. There is no U.S. law that says you have to comply with Article VI.

Mr. BRIDENSTINE. But under Article VI, correct me if I'm wrong, we, the U.S. government, have responsibility for those private ac-

tors, which is seemingly self-executing because that is not ambiguous.

Mr. BURNETT. Again, it's self-executing in the sense that it is a requirement on the U.S. government. It's not a requirement on a private entity.

Mr. BRIDENSTINE. Okay. So do you agree with Ms. Montgomery? Let's do that.

Mr. BURNETT. In part.

Mr. BRIDENSTINE. Okay. Did you want to address this, Ms. Montgomery?

Ms. MONTGOMERY. Yes. I would suggest that we should consider whether it's even self-executing on the U.S. government because it speaks of future activities, and the Supreme Court law that we see on that issue has us look at whether something has to take place in the future even when it's directed at the government itself.

Mr. BRIDENSTINE. And I heard you use the example of tourism, that we've been doing that and there is no authorization or continuing supervision. I would argue that there has never been a tourist that launched on a commercial rocket but only government-owned and -operated rockets, which puts it at a different level.

Ms. MONTGOMERY. Dennis Tito was a private person but I like your——

Mr. BRIDENSTINE. But he was on a Soyuz rocket, correct, a Russian Soyuz rocket?

Ms. MONTGOMERY. An American on a Soyuz rocket, a private American. But I do like your point about the levels because it goes to the question of whether something is important or scary enough to be regulated, and I think mining is a great example of that. Here on Earth, mining is dangerous. There's cave-ins, there's landslides, there's emissions, there's runoff, your neighbors get hurt, you know, bad things can happen from mining. But if you've got a robot mining an asteroid far away from everyone else, do you really need to supervise that or authorize that?

Mr. BRIDENSTINE. So when you talk about a robot mining an asteroid far away, that in my opinion probably doesn't need any regulation, but when you talk about a robot servicing a satellite in low-Earth orbit or even geostationary orbit and that robot of course is doing rendezvous and proximity operations, and of course, we have threats all around the world—Russia, China—that would claim that that would be a threat to their sovereign assets in space, and of course then as Doug Loverro has correctly identified, that gets the Department of Defense involved immediately along with the State Department, and according to your testimony, you suggested that the FAA can override the Department of Defense and the State Department for these non-traditional space activities because you said in your testimony that the FAA has the ability to make foreign policy apart from the State Department and could override them. Is that correct?

Ms. MONTGOMERY. I did say that, but one thing to keep in mind is that the FAA does not have authority on orbit so it could only override it for launch and reentry where it has authority, not where it——

Mr. BRIDENSTINE. So who has the authority in orbit?

Ms. MONTGOMERY. On orbit for rendezvous and proximity operations, right now, no one does, but that's okay under Article VI.

Mr. BRIDENSTINE. Okay.

Ms. MONTGOMERY. I don't disagree with my colleagues that if you have an actual safety concern——

Mr. BRIDENSTINE. So let me ask you——

Ms. MONTGOMERY. —you can regulate but it's not because of Article VI.

Mr. BRIDENSTINE. Would the State Department permit that launch to take place if the FAA authorized it and there is a risk—again, it wouldn't be our risk but it would be the Chinese or the Russians claiming that there's a risk to their sovereign assets, and of course, that starts the negotiating process. Would the FAA override that whole negotiating process? The important thing that I think we need to take away from this is that we have to have a mechanism to initiate the interagency process that ultimately results in an authorization, and Mr. Chairman, I know I'm out of time. If there's an opportunity to do a second round, I'd be very grateful.

Chairman BABIN. Thank you, Mr. Bridenstine.

Now the gentleman from Colorado, Mr. Perlmutter.

Mr. PERLMUTTER. Thanks to Drs. Babin and Bera.

Just a couple comments and then some questions. So Mr. Bridenstine and I are often on the same page on this kind of stuff, and we're on the same page again. But I do want to respond to a couple of partisan shots that were taken early on in statements, and you know, Dr. Babin said couldn't something be easily done fixed by the Trump Administration. I'm not sure anything can be done easily by the Trump Administration because they're taking so much time worrying about Russia, which Professor, is the elephant in the room, okay? So having said that, as a lawyer, you know you say freedom but there is no freedom in chaos and there has to be some organization here, and to you, Ms. Montgomery, you talked about brushing teeth, okay? I'm glad we're not regulating brushing teeth but you do need regulations for safety at the intersection down the block so that you're not in a crash and you have to have regulations as to property. So the title to my home, you know, we don't need the Wild West where somebody can come in and bump me out of my home and say well, wait a second, there's no regulation to title, you don't own it because the Constitution of this country ensures property rights, and so when you're talking about the robot on some distant asteroid, you know, maybe we don't need OSHA rules as to that robot but we do need rules as to the property because my clients always wanted to know that if they were going to invest something that they were going to own it. So that's my rant for a second.

And to you, Professor, I would just say I agreed with your sort of synopsis because Article VI has two other sentences besides just the one that Ms. Montgomery read, which I thought you did a very nice job trying to interpret that sentence but as a lot of judges would have said to me, nice try, that you don't quite get there. There is some level between the Wild West and a police state where we need some level of regulation, and we do have that responsibility under Article VI.

And so Professor, you talked about a light touch or a heavy tough, or regulatory heavy and regulatory light. I mean, where do you really think we should be? Because we don't want to stop innovation here but we also need to be able to protect property rights and safety and defense. So the floor is yours, sir.

Mr. BURNETT. Well, I actually prefer the regulatory light approach but I agree with you, there are certain things that we need to protect, and I think we can do that. I think we could, for example, have a registration kind of authorization where the actor or the proposed actor in space would register their activity, and I think you can define what that activity is. It's operation of a space object or it's the building of a facility on the Moon. I mean, those are quite clearly covered by the treaty. Define those and say okay, as soon as you register, you're authorized, and then you can provide the authority for the President or whoever you give the authority to to step in under certain circumstances and revoke that authorization if certain criteria are met but those criteria have to be clear. They can't be ambiguous and they can't be arbitrary.

Mr. PERLMUTTER. Okay. Ms. Montgomery, I mean, how as a lawyer would you go about protecting your client's property rights after they've spent $100 million to get to Asteroid X to start mining, and let's say the Russians say wait a second, that's ours? What are you going to do?

Ms. MONTGOMERY. I would agree with you.

Mr. PERLMUTTER. Good. Thank you.

Ms. MONTGOMERY. Because the treaty does have a rather scary provision in Article II in which it forbids national appropriation of objects in outer space. Fortunately, to some extent, that was cured by the Commercial Space Launch Competitiveness Act of 2015, but there are a lot of legal scholars out there who claim that it forbids private property. I do not agree with them, and I completely agree with your perception that there's a need for agreements and rules of the road usually from governments in property-right areas so that people can have title, so that they can get collateral, so that they can have certainty and plan for the future, and I do think that there are legal theories that would support private property in outer space even further than was taken in 2015 by this Congress. So in that respect, I'm in agreement.

On the Article VI, if I could, the point I'm making is a narrow legal one. We might see a need to regulate something but it should be the normal approach that Congress takes to whether there's a need to regulate something on the ground. Is there someone at risk? Is there a safety problem? Not just because Article VI says we have to regulate everything. It doesn't, and we shouldn't.

Mr. PERLMUTTER. No, and I agree with that, but I think given safety and property, there's got to be some role, and I think that that article does require that role, and that's kind of why I was agreeing with that light touch versus heavy touch, and I yield back to the Chair.

Chairman BABIN. Okay. Thank you.

And I must add that I didn't think I was firing a partisan shot when I said that I was looking forward to working with this new Administration when they develop a formal position on space.

Mr. PERLMUTTER. It wasn't you, it was Chairman Smith when he said the Obama Administration blah blah blah.

Chairman BABIN. Okay. All right.

Let's see. The gentleman from Arizona, Mr. Biggs.

Mr. BIGGS. Thanks, Mr. Chairman. Thanks to each of the panelists for being here. This has been very interesting.

Dr. Dourado, you talked about the development of the internet and permissionless innovation, and you basically talked about ex post manner of remedies for any basic liability or damage that might have occurred in the development of the internet. How do you see that working in space? Tell me about that. Is an ex post remedy always the best remedy?

Dr. DOURADO. Well, Congressman, thank you for the question. I think it needs to be combined with many other steps. So first I would say that I would like the U.S. government to provide as many informational resources as possible to private actors in space in order to prevent accidents in the first place. So there already is an active involvement between—collaborations between satellite operators to pull data on space situational awareness, and to the extent that the United States is willing to supplement that information or provide information about best practices and so on, in order to prevent harms in the first place, I think that that would be welcome. I think second would be welcoming and respecting the self-determination and self-regulation that is being already occurring in space. Third, I think courts are a very general—general fallback mechanism for when prevention is inadequate. We apply court decisions to so many other aspects of our lives, space is surely a unique domain but is it really so special that courts are not competent to address the harms that arise there, and I would submit that perhaps not. Perhaps courts can play a useful role in the—in ensuring that space is as safe possible.

Mr. BIGGS. And Dr. Dourado, courts don't always act ex post the issue as we heard earlier Mr. Loverro talking about the incident. It was taken care of outside the court, it was cooperative and collaborative in nature, but there are remedies ex ante, potential incidents as well. So I assume that we would all agree that we don't necessarily like litigation, having been a trial lawyer myself, but I actually liked it. But it isn't always necessary to partake in that.

So the other thing I wanted to ask you, Dr. Dourado, and I'm going to quote from your statement. "I urge the Congress to consider blanket authorization for all non-governmental operations in space that do not cause tangible harm to other parties, foreign or domestic, in their peaceful exploration and use of outer space." I am interested in the term you used, "tangible harm," and I wanted you to expand on that, please.

Dr. DOURADO. Sure. The reason I used that term is that Article VI refers to potential harm, and I think that that is a very expansive term and could be used to prohibit absolutely anything. Anything in space is potentially harmful. And what Article—what the Outer Space Treaty would require would be for the United States to consult as appropriate where we cause potential harm to the activities of other state parties. And so simply deeming it not appropriate to consult every time there's potential harm but not tangible harm is within the scope of Congress's authority.

Mr. BIGGS. Thank you.

And Mr. Loverro, I'm going to quote you now. You said "There are many ways to skin this cat," and so I'd like you to, if you would, explain your preferred policy recommendation to this Committee.

Mr. LOVERRO. Yes, sir. Thank you very much.

I think I'm in very strong agreement with Mr. Burnett and some of the things that Dr. Hogue has said here. I do believe that we need some very basic safety regulation that would ensure that we don't have unmitigated collisions in space, and that—as a former private pilot, if I was flying by visual flight rules, I knew there were certain altitudes I could fly at and certain altitudes I couldn't fly at. If you're an unguided small sat, then you should stay below the orbit of the Space Station because otherwise you have the potential to hit it, and that should be a simple rule that doesn't require regulatory oversight. It's simply a rule that everybody knows you can follow.

Mr. BIGGS. Are you suggesting something akin to filing a flight plan?

Mr. LOVERRO. Not so much a flight plan but the knowledge that a rule exists, certainty of what rules exist, and what rules do not exist, rules that you have to follow, and that allows then the authorization and registration that Mr. Burnett talked about to occur because you now will register within accordance of those rules. This doesn't require a government entity now to go ahead and give permission. It simply provides a set of rules that exist to ensure safe spaceflight.

Mr. BIGGS. So you would be saying that by filing something, registration basically, that that meets the authorization requirement of section 6?

Mr. LOVERRO. Right. Well, as I said earlier, I'm not a lawyer and I don't actually believe that what drives us should be section 6.

Mr. BIGGS. Okay.

Mr. LOVERRO. I think what drives us should be what's good for America.

Mr. BIGGS. Thank you.

Thanks, Mr. Chairman.

Chairman BABIN. Okay. Thank you.

It's been requested, and I think we'll grant an extra two minutes for questions for whatever membership would like to do so, and so Mr. Bera, I'd like to call on you.

Mr. BERA. Great. Thank you, Mr. Chairman.

Chairman BABIN. Oh, okay. Hold on. Let me back up because I'd like to recognize myself first—I apologize—as the Chairman. Sometimes I forget my leadership position here.

Mr. Burnett, in the Outer Space Treaty and the Liability Convention, the United States agreed to be liable as a launching state. This raises concerns about whether the United States should impose more regulation on the private sector in order to protect against liability. How could bilateral agreements and reciprocity mechanisms be used to mitigate against liability for the United States as a launching state?

Mr. BURNETT. Well, I'm not sure that the activities we're talking about here really raise any serious issues of liability. Now, they

might in the future. But if you look at what we've done with our responsibility for liability in the launch area, we have a requirement for insurance, but that requirement doesn't extend to satellites that are communication satellites. It doesn't extend to remote sensing satellite because the risk of some liability really occurs on the launch, it doesn't really occur in space because on the launch you've got a potential of absolute liability but once you're in space, you're in the fault regime, and when you're in a fault regime, you have to prove that there's been negligence or something like negligence, and the liability is a national liability, and so the issue of the liability of one nation to another nation—it's not from one nation to a private party—becomes a political issue.

Chairman BABIN. Right.

Mr. BURNETT. So there are other ways to solve it other than requiring insurance or posting a bond or something like that.

Chairman BABIN. Okay. Thank you.

And just one more. Ms. Montgomery, is the United States liable for all private sector activities under the Outer Space Treaty?

Ms. MONTGOMERY. I do not believe that is the case. Under both the Outer Space Treaty and the Liability Convention, we see that a country is liable if it is a launching state, and there are only four ways to be a launching state. It's going from your territory, your facilities, the government is procuring the launch, and then there's liability for private actors which take place off the ground, and as Dennis said, that's fault-based. But—so there's limits on what activities United States would be liable for, and it's not for everything.

Chairman BABIN. Okay. Thank you.

Now I'd like to call on the gentleman from California, Mr. Bera.

Mr. BERA. Thank you, Mr. Chairman.

A quick question, Mr. Loverro. Several stakeholders have cited the interagency review process for commercial remote sensing licensing as a process that's led to undue delays, stifled innovation, economic capabilities and commercial operations, and one of the reasons why we shouldn't—the interagency review should not be any part of this mission authorization approach. Is this a valid concern? If so, why? And if not, why not?

Mr. LOVERRO. So sir, I will tell you that I think it is a valid concern that that licensing regime has stalled innovation, and quite frankly, again, it goes back to what Mr. Burnett said. The black box that went in was undefined and people within government, all right-minded, mind you, defined it as they would, and I personally worked against that in order go ahead and make that free, to try to go ahead and truly get down to the concerns that Congress had expressed in the statute, which is show me that there's a true national security harm and then we should go ahead and regulate or prohibit but otherwise don't regulate or prohibit.

I think this is the same problem we're dealing with here. Interagency review is important. The interagency has a different perspective. But that interagency review needs to be bounded. We can't just tell the interagency you have authority to do this and leave it up to them to decide on what basis they will make those decisions because we bureaucrats tend to go ahead and accumulate power that we were never intended to have.

So I think we need to be clear. Your concern is a safety concern. Make sure there's no collision. Your concern is this concern. Let's be very clear about what we're giving them authority to do and then allow that interagency process to do that within those limited bounds.

Chairman BABIN. Thank you, Mr. Bera.

Now I'd like to call on the gentleman from Oklahoma, Mr. Bridenstine.

Mr. BRIDENSTINE. Mr. Chairman, I have a letter here from Dr. Mark Sundahl I'd like to enter into the record. He's a Professor at the Cleveland Marshall College of Law.

[The information appears in Appendix II]

Chairman BABIN. That'll be noted.

Mr. BRIDENSTINE. Okay. I wanted to bring to the attention of the panel here, and I know there's agreement and disagreement maybe about how Article VI should be applied.

Dr. Sundahl disagrees with the panel. I like your position better, Ms. Montgomery, quite frankly, but one of the things he says is, "However, the need to adopt a bill"—he's talking about some kind of bill for starting an interagency review process—"is equally driven by industry demand for regulatory clarity," and I would say not just regulatory clarity but certainty and permanence so from one Administration to the next there's not this ambiguity.

And your testimony, Ms. Montgomery, clearly indicated the same thing when you say "However, since the issue of what Article VI means has created legal and regulatory uncertainty, Congress could lay that uncertainty to rest with a directive to regulatory agencies to abstain from using the lack of federal oversight of a particular activity as a reason to deny a payload review." So we're talking about a directive to regulatory agencies to abstain from denying a payload review, a launch, a reentry license or authorization for satellite transmissions or remote sensing.

Mr. Chairman, I fully agree with this, and if we can get that kind of certainty that creates the agencies from abstaining from those kind of activities on these non-traditional space activities, I fully support it. One of the challenges that is there, Ms. Montgomery, you say there are clear advantages to this path. It would of course create certainty, which would be good. We want that certainty, which is helpful to industry's quest for innovation and investment. So there is currently uncertainty. I think everybody agrees with that. That uncertainty is creating a challenge to innovation and of course capital investment, which is what Ms. Montgomery said here.

The question is this: if we can't pass this bill that makes these agencies abstain from denying these activities, what do we do then? At that point, do we just accept the limitation on innovation? Do we just accept the fact that it's going to preclude capital formation? That's my question, Ms. Montgomery.

Ms. MONTGOMERY. No.

Mr. BRIDENSTINE. We don't accept it?

Ms. MONTGOMERY. We don't accept it.

Mr. BRIDENSTINE. But we'd have another approach?

Ms. MONTGOMERY. Yes. The fact of the matter is that my recommendation is basically codification of the existing state of the

law. We go look at the Supreme Court opinions and we apply them correctly and properly and knowingly, and say look, we can't stop you from going because we don't have a self-executing treaty here.

Mr. BRIDENSTINE. So Mr. Loverro, what would the State Department or the DOD have to say about that?

Mr. LOVERRO. Sir, I think we would be concerned about that kind of approach. While I am absolutely 100 percent in favor of innovation and experimentation in space, there are implications that transcend our Article VI treaty obligations and rather go ahead and move into things like the United Nations Treaty and the need to go ahead and practice secure defense, the need to avoid harm to other nations' property. We have requirements throughout our landscape that assure that actions the United States take doesn't harm other nations, and in this case, actions we take in the commercial world doesn't harm other commercial operators.

I think—again, I am very much of the mind that we need to do as little regulation in this realm as possible but we do need to assure that our actions don't harm our own companies, our own national security or interest of other nations.

Mr. BRIDENSTINE. Thank you, Mr. Chairman. I yield back.

Chairman BABIN. You're welcome.

And now Mr. Beyer.

Mr. BEYER. Thank you, Mr. Chairman. I think it is pretty cool that we have two doctors leading this Subcommittee, on the Science Committee. That's a good thing.

It seems to me that the whole idea of this hearing was trying to figure out how we respond to the spirit and letter of Article VI, you know, light regulation, heavy regulation, permissive innovation and all that. I was fascinated by something in Mr. Burnett's testimony, and this goes back to 1967, and let me quote."Ambassador Goldberg used the term 'self-executing' to apply to provisions of the treaty that are to be understood to be subject to no further conditions and no further refinements such as Articles IV and VI, or IV and V. Ambassador Goldberg distinguished these provisions, Article IV and V, with other provisions of the treaty that are understood the statements of general principles, principles that state a worthy purpose, that need further study, exploration and elaboration to develop the rules to govern the use of outer space. Following this line of reasoning, only the treaty provisions that were understood not to be subject to further refinements should be considered as provisions that are required conditions of the authorizations required by the treaty."

If I read all this, does that mean that Article VI is now moot, irrelevant and we didn't need this hearing at all?

Mr. BURNETT. In my interpretation, the answer to that is no, Article VI is one of those provisions that we've agreed is going to apply immediately, just like the obligation not to put in orbit nuclear weapons, not to put military facilities on the Moon or other celestial bodies. I think Article IV falls into that category. I think there are other provisions in the treaty that clearly were identified by Ambassador Goldberg to be things which we are going to study and that we hadn't really reached a consensus on how to go forward on those.

Mr. BEYER. And that would be Article VI?

Mr. BURNETT. No, that would not be Article VI.
Mr. BEYER. Not Article VI? Okay.
Mr. BURNETT. Correct.
Mr. BEYER. All right. Great. Thank you very much.
Mr. Chair, I yield back.
Chairman BABIN. Yes, sir. Thank you.
Now I'd go to Mr. Biggs, two minutes.
Mr. BIGGS. Thank you, Mr. Chairman.
Chairman BABIN. Yes, sir.
Mr. BIGGS. I feel bad for Dr. Hogue because you've been—I want you to know your testimony was not ignored so I have a question for you, sir. I saved it for my last effort.

You talked specifically about non-governmental organizations that regulate certain conduct and activities such as the International Antarctic Trade Organization and FINRA. My question for you is, can you describe whether those have been successful achieving their organizational ends?

Dr. HOGUE. I don't have a good answer for you on that but I'd be happy to go back and provide that after the hearing.

Mr. BIGGS. Well, thank you. You've set me up to move right on over to the rest of the panel, which is, is there any organized cooperative or collaborative effort to address some of the issues we've been talking about today, internationally, that you're aware of, and if so, can you please describe those briefly? And I guess we'll just start with—several of you are nodding your heads. Ms. Montgomery first, please.

Ms. MONTGOMERY. Yes. The U.N. addresses a lot of the debris issues and has issued guidelines on them. There is also an industry association, the Space Data Association, that coordinates amongst themselves as to—so as to make sure they don't bump into each other and cause debris.

Mr. BIGGS. Dr. Dourado, in our previous exchange, you mentioned, essentially I'll say transparency from governmental organizations as to where their space debris or space activities are. Can you elaborate on that, please?

Dr. DOURADO. Certainly. The Department of Defense currently has much higher-resolution data on space situational awareness than does the Space Data Association that Ms. Montgomery referenced, and I think it would be useful for the U.S. government to share some of that data with the private sector in order to improve their capabilities.

Mr. BIGGS. Thank you.

Mr. Chairman, I'd ask that the witnesses be allowed to answer the questions.

Chairman BABIN. Yes.
Mr. BIGGS. Thank you.
Mr. Loverro?
Mr. LOVERRO. Yes, sir. Thank you.

As Ms. Montgomery said, there are several activities under sponsorship of the U.N. One of them that my office was heavily involved in is called CPUOS, the Committee on the Peaceful Uses of Outer Space, that were trying to go ahead and look at what kind of rules would we need to use internationally to guide our use of space. I found it quite frankly very unfortunate that the United

States had not established its own rules first that we could then take to CPUOS and convince others to use. We had done this in the debris guidelines that were mentioned earlier. NASA developed a set of standards, guidelines, on orbital debris that we then took as a nation to CPUOS and convinced the rest of the world they should follow. That's good for the United States. We should do it again here. We should have a position in CPUOS other than to say we have no position because that leaves the floor open for others to go ahead and insert their position.

Mr. BIGGS. Thank you, Mr. Chairman.

Chairman BABIN. Yes, sir. Thank you.

And now I'd like to call on the gentleman from Florida if you have some questions for 2 minutes.

Mr. WEBSTER. Thank you, Mr. Chairman.

Ms. Montgomery, in the Outer Space Treaty, is the United States liable for all activities, private activities?

Ms. MONTGOMERY. No, sir, it is not. It has to be a launching state or it has to be internationally responsible for damage on orbit. So there are limitations to that. You have to be the territory or facility from where an object is launched or you have to be procuring it, and if those criteria are not satisfied, then the United States is not a launching state and not liable.

Mr. WEBSTER. Do you have any concerns about that?

Ms. MONTGOMERY. I think that if the United States is not liable, then the private actor will be liable, so whoever is damaged will be made whole by bringing a suit against the actual causer of the damage just like in the rest of life.

Mr. WEBSTER. Would there be a need for a statutory provision in order to accomplish that?

Ms. MONTGOMERY. No, sir.

Mr. WEBSTER. Thank you.

I yield back.

Chairman BABIN. Thank you.

I want to thank the witnesses for their very valuable testimony and the members for their questions. It's been very informative. The record will remain open for two weeks for additional comments and written questions from members.

And with that, this hearing is adjourned.

[Whereupon, at 11:52 a.m., the Subcommittee was adjourned.]

Appendix I

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Ms. Laura Montgomery

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

"Regulating Space: Innovation, Liberty, and International Obligations"

Ms. Laura Montgomery, Attorney and Sole Proprietor, Ground Based Space Matters, LLC

Questions submitted by Ranking Member Ami Bera, House Committee on Science, Space, and Technology

1. How can we use a mission authorization process to address the growing orbital debris problem?

Answer: Thank you for the opportunity to be of further assistance on this important question. If Congress were to use a mission authorization process to address orbital debris hazards, I recommend that it be a transparent, narrowly-tailored approach in order to be legally adequate. Past proposals for mission authorization have been so broad that they would not have allowed the regulated industry to know what was required of or forbidden to it. It is my own opinion that requiring authorization is unduly burdensome at this stage of industry development, and that a notification regime coupled with "rules of the road" would suffice for addressing orbital debris.

Authorization. First, the term "mission authorization" itself is too broad and could lead to confusion on the part of the regulated industry and a regulatory agency as to the scope of the agency's authority. A "mission" might be interpreted to encompass far more than just those activities that would add to the growing orbital debris problem, and could be stretched to include activities on the Moon and elsewhere. Accordingly, it would be best to identify the activity requiring authorization with the right amount of specificity and clarity. For example, if Congress were to decide that orbital transportation vehicles, satellite servicing devices, and orbital habitats served as possible sources of orbital debris, Congress could identify and define those objects in legislation, and require their authorization by license, permit, certificate, or other means of regulatory approval.

In truth, little legal significance attaches to the choice of nomenclature for the authorization. Congress determines the significance. For example, if Congress wished to assign the oversight of these spacecraft to the Federal Aviation Administration, provide the financial responsibility protections and obligations of 51 U.S.C. ch. 509 (Chapter 509, often referred to as the Commercial Space Launch Act), and its time-limited constraints on regulating the safety of space flight participants, Congress could characterize the authorization as a license and place the new authority in Chapter 509 to achieve that result.

In this scenario Congress could, for example, require a license for the "operation of an Earth-orbiting spacecraft," define "spacecraft" to mean an orbital habitat, an orbital transportation vehicle, or a satellite servicing device, and make all other necessary conforming amendments to Chapter 509. Such an approach would parallel Chapter 509's requirement that anyone conducting the "launch of a launch vehicle" must obtain a license.

Purpose of regulation. The next step would be to confine the agency's regulation to addressing the hazard of orbital debris. There the legislation would address that hazard specifically, by name. Regulating for purposes of "safety" is too vague, and could invite a wide array of regulations, many of which could exceed the scope of the current question's concern, namely, debris-causing collisions. Congress would achieve greater clarity if it were to instruct a regulatory agency to issue a license when the operator of a spacecraft demonstrated it could operate without causing collisions. This is similar to how a launch operator obtains a launch license. Regulation of this nature is not, however, the least intrusive means available for addressing the orbital debris problem.

Notification. A more flexible approach would be to merely require that the operator notify the government of its intended operations. It is not necessary that the government issue a license or other form of authorization, because such a requirement does, in fact, result in delay. However, if Congress were to determine that authorization was required, authorization of an activity could attach as soon as the operator notified the government of its proposed activity. Existing regulatory regimes may already accomplish notification. Because so many operators would already possess a license or other form of authorization for remote sensing or space-to-ground communications, additional notification could be redundant. Regardless of whether Congress created an additional notification regime or relied on the existence of the Federal Communications Commission's and National Oceanic and Atmospheric Administration's regulatory regimes, notification resulting in immediate authorization would reduce regulatory delay while at the same time allowing the government to know that one of its citizens proposed an activity, the location of that activity, and how to contact the operator.

Rules of the Road. Currently, entities such as the U.S. Department of Defense and the SDA offer a service in the form of data about objects on orbit, conjunction likelihoods, and a means of coordinating the owner of the other object. These clearinghouses do not act as regulatory so much as facilitators, where all the parties have a strong interest in avoiding collisions. These clearinghouses have likely organically created some protocols, some "rules of the road" for mitigating harm. Because a collision would harm an operator's property, each operator has a strong incentive to cooperate in any mitigation efforts. Mr. Loverro's story of advising an entity of a possible concern, and that entity's positive response show that the incentives line up properly for most parties. Not all collision will be averted, but that would be the case even with regulation.

Rather than creating a regulatory regime for what appears to be a matter of providing a service or information, Congress could obtain input from industry as to existing rules of the road that might have developed through entities such as the Space Data Association, or it could ask industry organizations what practices aid in avoiding collisions now. No commercial operator wants to court the risk of collision, which is why entities such as the SDA have been formed. It might be best to rely on them so that Congress or a regulator doesn't codify rules that will become obsolete in a decade. Congress could also explore whether a private entity such as the SDA has enough data to serve as a clearinghouse for orbital operators, or whether additional arrangements with the U.S. Department of Defense could help.

Responses by Dr. Eli Dourado

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

"Regulating Space: Innovation, Liberty, and International Obligations"

Dr. Eli Dourado, Senior Research Fellow and Director, Technology Policy Program, Mercatus Center, George Mason University

Questions submitted by Ranking Member Ami Bera, House Committee on Science, Space, and Technology

1. In your statement, you urge application of permissionless innovation to space and cite that predicted negative consequences associated with national security concerns over "liberalization" of the Global Positioning System never came to pass. You also propose that Congress consider giving blanket authorization for all nongovernmental operations in space as long as they "do not cause tangible harm to other parties, whether foreign or domestic."

    a. What means do you recommend Congress use to determine that a nongovernmental operation would not initially or in the future cause tangible harm? What is an example of what you would consider to "cause tangible harm to other parties"?

    Answer: My proposal is not that Congress make an ex ante determination with regard to whether a nongovernmental operation will cause tangible harm. Rather, I propose that nongovernmental operations be presumed legal unless they cause tangible harm.

    This is simply a continuation of the status quo. Today, excepting launch, reentry, and activities that affect radio spectrum, there is no regulator that provides prior approval for activities in space. To my mind, nobody has convincingly made the case that this status quo does not strike the appropriate balance between safety concerns and innovation. The justification for a potential authorization framework, rather, has been that one is necessary to comply with the Outer Space Treaty. My proposed blanket authorization framework perpetuates the substance of the status quo while addressing those treaty compliance concerns.

    I would consider tangible harm to encompass any loss of life or limb in space, or any damage to property, such as that caused by a conjunction. Should such a harm occur, the aggrieved party, whether domestic or foreign, could sue in US courts. Under my framework, there would be no legal defense available that the US government authorized the operation, since the US government would not authorize harmful activity.

    b. Mr. Loverro stated in his prepared testimony that few, if any, individual operators have either the ability to assess the risk their activities may pose to other space

flight missions or the resources or ability to ameliorate the damages their actions might have on those missions. How would Congress be able to do so for U.S. vehicles, as well as for the even more challenging question of whether foreign space vehicles could be harmed?

Answer: Although few individual operators have the ability—on their own—to assess the risk their activities pose to other actors in space, it is simply not true that private actors working together would be unable to develop that capability. Indeed, some of them are already doing so through private organizations such as the Space Data Association, which provides space situational awareness to satellite operators.

More generally, there has been a growing consensus among political economists over the last decade that the "tragedy of the commons" problem is often overrated. The late Elinor Ostrom became the only woman to win the Nobel Prize in Economics for her research on how common pool resources can be governed from the bottom up, by communities of participants appropriating those resources.

Ostrom's research spanned numerous kinds of common pool resources such as fisheries, forests, and irrigation systems around the world. While she was careful to emphasize that there are no panaceas, she developed a series of eight indicators for when bottom-up governance can work. Among these is that the self-determination of the community must be recognized by higher authorities.

Following Ostrom's pathbreaking work, it would be wise for Congress to recognize attempts by the space industry to self-regulate. The Space Data Association is a prime example of such an attempt. As private solutions to the difficult problem of space situational awareness develop, Congress, and the US government more generally, could access the information produced by these initiatives as a customer or a peer.

Incidentally, the difficulty of developing a solution that scales to handle interaction with foreign space vehicles is a strong argument for bottom-up, industry-led solutions, rather than top-down, government-imposed regulation. The Space Data Association's membership is already international, and as a consequence, it is already playing a role in ensuring that foreign nongovernmental operators are acting responsibly. This is something that new US regulations on missions in space would be unable to achieve.

Responses by Mr. Doug Loverro

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

"Regulating Space: Innovation, Liberty, and International Obligations"

Mr. Doug Loverro, Former Deputy Assistant Secretary of Defense for Space Policy

Questions submitted by Ranking Member Ami Bera, House Committee on Science, Space, and Technology

1. What are the risks of not having a framework in place to "approve" or "authorize" non-governmental missions that do not currently fall under existing authorities? Could we run the risk of the U.S. being forced to follow an approach developed by other countries that is not favorable to the U.S. space industry?

   Answer: It is abundantly clear that at some not-too-distant point in the future, the world will adopt rules that regulate traffic in space either as a consequence of increased international use and the disagreements that will result from that multi-nation use or, more dramatically, due to an accident in space that significantly impacts the assets of two nations. It is further likely that rules adopted in that environment will be focused on assuring safety above, and even possibly in conflict with, commercial benefit. This is not a preferable future for US space entrepreneurs and business concerns. It is in our interest to establish common-sense rules now that both enhance economic benefit and responsibly reduce the hazard to on-orbit activities. Once established by the US, these types of rules will become the *de facto* basis for any international effort. Plus, they will enhance the ability of US-based space firms to act today, without having to wait on international standards to be adopted.

2. In your prepared statement, you note that it is "*in the National Security interest of the U.S. to encourage an innovative commercial space sector*". With that in mind, how can we ensure that any guidelines, measures, or regulations that are adopted as part of a mission authorization process do not stifle the innovation that is so important to our national security and to our commercial space activities?

   Answer: We need to grant the fact that there is no a priori way to guarantee that regulations would not impact, in some ways, innovation. But should always be the goal of regulations to enhance the conditions for innovation, rather than stifle those conditions. The best way to achieve that goal is to assure that any rule-making authority is legislated to include a formal role for industry advice with oversight of the process by a non-partisan, non-executive branch body such as the current FAA sponsored COMSTAC (Commercial Space Transportation Advisory Committee) or NOAA sponsored ACCRES (Advisory Committee on Commercial Remote Sensing) bodies. While neither of these two existing bodies covers the full range of space innovation, they, or an easily created analogue, should be established

to provide direct advice to the Executive and Legislative branches on any proposed regulations.

3. The Commercial Space Transportation Advisory Committee (COMSTAC), which advises the FAA Administrator on matters concerning the U.S. commercial space transportation industry, issued a finding from its October 2016 meeting "*that the current lack of an explicit, defined process for commercial space activities that are not currently explicitly supervised by a U.S. Government Agency has resulted in a lack of stability, predictability, transparency, and efficiency, which has, and will continue to, hinder the development of U.S. commercial space activities*". Based on the interaction with industry that you had in your former position, what are some potential means by which such explicit supervision by the government could be applied?

   Answer: In my former position, and still today, I perceived that the best way to establish the basis for such supervision was to empower the FAA to begin to craft standards and guidelines in cooperation with industry that would then be captured in regulation. I believed that the basis for that regulatory oversight was best captured in the mission authorization approach so that it was not overly statutorily prescriptive, in the way that remote sensing stature has become, on the ability for government and industry to come to common sense conclusions about how to apply such authority. I would reiterate my strong belief that no regulatory process is immune to abuse that could constrain innovation, and that an industry advisory committee with direct input to both the FAA Administrator and the Congress is a required element of the process.

4. If non-governmental entities are not required to abide by the Outer Space Treaty's requirements unless Congress takes an affirmative action directing such a requirement, is there a risk that some countries could conceivably create state-run companies with the sole purpose of circumventing any aspect of the Treaty? How could Congress prevent the potential for a "bad apple" actor whose nongovernmental mission intentionally or unintentionally poses the risk of harming U.S. government or commercial space activities?

   Answer: There are certainly mechanisms that other states could establish to circumvent the intent of the Outer Space Treaty. In fact, the Russian space flight firm Roscosmos was recently (Dec 2015) turned into a state-run corporation following its poor performance in commercial space flight. While this should not imply any ill-intent on the part of the Russian government to use Roscosmos to circumvent the Outer Space Treaty, the point is that outside the US, most space activities are never very far from government control, regardless of specific structure. I do not think it is possible for Congress to use its domestic legislative power to constrain these kinds of activities of

other nations. But by leading the way to an enhanced, commercially sensitive and safety-focused regulatory structure, the US is very likely to positively influence the way other space-faring allies address these issue, and that multilateral agreement is then more easily extended to non-like-minded actors.

5. In response to a question from Congressman Beyer on relaxing GPS granularity to open opportunities for new industries, you responded that while at DOD, you were an advocate for loosening restrictions on commercial imaging. Was your response meant to illustrate that loosening of commercial imaging is an analogue to relaxing GPS granularity and that in your view relaxation of GPS signals should likewise be allowed?

   Answer: Unfortunately, I misunderstood Congressman Beyer's question—I thought he was asking about remote sensing and not GPS granularity. So, while my answer correctly outlined a forward-looking policy for remote sensing, I did not address his real question on GPS. What I should have said on that account was that there is no reason national security rational for not allowing the best accuracy GPS to be made available to the general public, and in fact, the DoD was in the process of fielding new GPS signals that would greatly enhance that precision for both military and civilian users. I was fortunate enough to be able to be running the GPS program for the nation when we were asked to begin planning for that enhanced precision and the plan we developed, if they are fully implemented, could provide accuracies as precise as 10 cm (about 4 inches) to properly equipped users. It is my belief that such accuracies provide a quantum leap in the potential for location based services, especially in eras of self-driving cars, smart highways, drone deliveries, and a host of services we have not even yet conceived.

6. In your prepared statement, you urged the development of flight safety guidelines that provide advantages for the U.S. commercial market. The term "Code of Conduct" has been used by the European Union and has met opposition from other countries. In what way do the flight safety guidelines you propose differ from the European Union's "Code of Conduct"? Are the flight safety guidelines you envision a form of "Rules of the Road"?

   Answer: The EU Code of Conduct was a security-focused construct created and executed through the national security arms of the various governments involved, including the US. While many of the actual rules or standards that the Code addressed had strong overlap with rules that could be envisioned solely for safety-related purposes, it was clear in all discussions related to the code that the purpose was to constrain nation-state security related activities in space, and not to provide for general safety. As such, the Code never had any real support from western alliance adversaries who were in

the midst of engaging in exactly the kind of systems and activities that the code would have restricted. So, while the rules may bear some resemblance, the intent was completely different. This creates a huge difference in international acceptability. It is quite easy for both allies and adversaries to see how safety-related rules might be in their interest, since safety-related restrictions would not restrict national security-related activities in space any more than rules for safety in the air or maritime domains restrict national security-related activities in those domains. The rules for commercial air transport re safety-based, and agreed to by all nations. These rules do not impact how the US, our allies, or our adversaries plan or execute national security-related flight activities.

7. Is there validity to the argument that regulations or licensing requirements as part of a mission authorization could drive U.S. companies to "set up shop" in other countries? If so, how would you recommend structuring a mission authorization framework to mitigate that concern?

Answer: It would be naïve to suggest that regulations and licensing requirements could not potentially create the incentive for firms to move off-shore, especially if such regulations were overly restrictive or burdensome. So, there is no question that we must be sensitive to that potential and guard against an overly restrictive approach. But experience in the optical remote sensing industry, where regulations are already somewhat burdensome, demonstrates that even with that overly prescriptive approach, firms still prefer to be US-based due to better access to venture capital, technology, stable business conditions, and a government intent upon leveraging their products. This is not to imply that we should not be sensitive to this concern—it is real and it must be strongly considered in any process we craft. And this is why the involvement of industry, and oversight of the process by an independent body is so critical, especially in this early stage or regulation.

We made the mistake in remote sensing, due to an overabundance of national security caution, that development of standards for regulation of commercial radar sensing was to be done solely by government behind a wall of security and classification, and that structure led to the loss of the potential radar-sensing industry to other nations despite the fact that the US was technically well ahead. So, we must not allow that to happen in this instance. Rules for this industry must be developed with industry participation, such as is being done today by DARPA in the CONFERS (Consortium for Execution of Rendezvous and Servicing Operations) process, and subject to independent review.

8. What should a mission authorization consist of, i.e., what criteria/requirements should be met before a mission is authorized?

   Answer: Very simply, mission authorization should be framed against a safety backdrop. This means that the purpose of mission authorization is to ensure that the physical aspects of space flight can be carried out in a safe manner for both the subject spacecraft and for other space users. In general, this type of structure would focus on a handful of critical aspects such as:

   1) Is the proposed flight path for the space mission likely to create a hazard for other already on-orbit space systems and, if so, are there alternative orbits that would reduce that hazard? Do either of the systems have the ability to maneuver in case of a predicted collision?

   2) Is the proposed space mission being implemented in such a way as to minimize the release of debris?

   3) Is the proposed space mission able to be tracked in orbit, or, if it's orbit potentially intersects other missions, has the space mission provided a means of enhancing its trackability to reduce uncertainties in its track?

   4) Does the proposed space mission have a disposal plan that complies with generally accepted disposal standards?

   5) Are there other hazards caused by this space mission which should be mitigated prior to the issuance of a flight license?

   This is not an all-inclusive list, but indicates the types of issue that should be addressed in the mission authorization process. I would strongly advise against non-flight safety related conditions (e.g., does the space mission comply with US national security concerns) as these become far too subjective and create a backlog in the process.

Responses by Mr. Dennis J. Burnett

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

"Regulating Space: Innovation, Liberty, and International Obligations"

Mr. Dennis J. Burnett, Adjunct Professor of Law, University of Nebraska-Lincoln, College of Law

Questions submitted by Ranking Member Ami Bera, House Committee on Science, Space, and Technology

1. Who decides whether U.S. obligations are being met under the Outer Space Treaty and by what means is this determined?

   Answer: There is no super-national authority for deciding whether U.S. obligations are being met under the Outer Space Treaty ("Treaty"). The implementation of the Treaty is at the discretion of each national signatory. Resolution of a dispute about whether a nation is or is not complying with the obligations of the Treaty is, in the first instance, a diplomatic matter. In theory a dispute about the interpretation of the Treaty could be submitted to the International Court of Justice ("ICJ"), but only if both nations concerned agree.

2. In response to a Member's question, Ms. Montgomery responded that the U.S. government is not liable for incidents during non-traditional activities despite having granted "mission authorization" or approval to U.S. commercial space entities and cited the Space Liability Convention as the reason.

   a. Do you agree with her position? If not, why not?

   Answer: The grant of a "mission authorization" and the liability of the United States under the provisions of The Convention on International Liability for Damage Caused by Space Objects, ("Liability Convention") are not necessarily related. The international liability is determined not by the grant of the "mission authorization" by a US government regulatory body, but by the terms of the Liability Convention.

   The Liability Convention provides for international liability of the "launching state." The term "launching state" is defined in Article I of the Liability Convention as:

   "(i) A State which procures the launching of a space object;

   (ii) A State from whose territory a facility or space object is launched."

   Consequently, if the United States is not the State procuring the launching of the space object that causes the damage or is not the State from whose territory such space object that causes the damage is launched, the United States has no liability under the Liability Convention even if the U.S. has granted a "mission authorization" for the space object in question.

b. Does providing mission authorization imply any indemnification of the non-governmental party? For example, if an authorized nongovernmental mission includes a spacecraft that leaks hazardous fuel and the leaked fuel impacts another orbiting spacecraft, is the U.S. liable?

Answer: The grant of a mission authorization does not imply any indemnification of the non-governmental party.

The Liability Convention governs the liability of one signatory nation to another signatory nation. The process for making and resolving a claim by one signatory against another signatory are set forth in Articles VIII though XX. In particular, Article IX provides that claims must be presented to a launching state through diplomatic channels. Consequently, there is no private right of action that arises from the Liability Convention. Article VIII provides that a claim of one signatory nation against another signatory nation may include damages to the nationals of the claiming nation. However, it should be clear that the liability, if any, under the Liability Convention is a liability only of a signatory nation and not a private party.

As noted previously, in my opinion the grant of a mission authorization does not either create or destroy the liability of the United States under the Liability Convention.

With regard to any claim under U.S. law (either federal law or state law) against the United States by a private party, it is assumed that the doctrine of sovereign immunity would apply unless Congress has waived the immunity. A detailed analysis of that type of liability, if any, is beyond the scope this response.

3. You characterized the State Department's interpretation for "continuing supervision" as asserting that there is no continuing supervision if there is an absence of a mechanism for the U.S. government to ensure that the proposed activities will be carried out in conformity with the treaty. In your view, was the State Department's interpretation consistently applied to support its positions regarding FAA's Payload Review of proposed Bigelow and Moon Express lunar missions?

Answer: I believe that I characterized the State Department's interpretation for "continuing supervision" as requiring some type of contingent approval; *i.e.*, that the approval could be withdrawn or revoked if certain conditions were not met. Those conditions could include conformity with the treaty. To be clear, I also suggested that Congress should legislate the conditions and the objective criteria for determining if the applicant is in compliance.

I believe that the payload review for Bigelow and Moon Express involved quite different circumstances and that the resulting actions by the FAA reflected the differences in circumstances. The response to the Bigelow request indicated that interagency differences precluded a definitive answer. I also believe that the Bigelow request was not time

critical. On the other hand, if I am informed correctly, the Moon Express payload review was specifically a one-time, time critical and non-precedent setting matter. Furthermore, I believe that fact that the Moon Express mission would end and that there would be no continuing activity was critical to the payload review.

If my understanding of the facts and circumstances is correct, then I believe that the position of the State Department was applied consistently.

4. Is a "permissionless" approach to innovation consistent with U.S. obligations to demonstrate compliance with the Outer Space Treaty and Article VI on authorization and continuing supervision? What would happen under this approach if there were a bad day and national security, humans in space, or multiple collisions occurred as a result of a "permissionless" approach to non-traditional missions? What if other nations followed this same approach?

   Answer: In my opinion, a "permissionless" approach to activities in the exploration or use of outer space would not be in compliance with Article VI of the Treaty. This answer assumes that "permissionless" means that there is no action by the United States to authorize the activity. However, a blanket permission enacted either by law or regulation to authorize certain types of activities combined with some form of continuing supervision (which could include something as simple as filing a certification of compliance on a yearly basis) would not be "permissionless" and would meet the minimum requirements of Article VI of the Treaty.

   It would be a bad day indeed if the US were to allow nationals to engage in activities in outer space without any authorization or continuing supervision. Not only would the United States be subject to claims for violation of the Treaty provisions, but the United States would find itself in a position of not being able to hold other countries responsible for the actions of their nationals. If other countries were to follow a "permissionless" approach there would be no international accountability. Such an approach would not be in the national security or foreign policy interests of the United States.

5. You indicated in your prepared statement that one interpretation of the Outer Space Treaty "*does not prohibit the U.S. from attaching conditions to authorizations that exceed the minimum requirements of the Treaty*". In your opinion, are collision avoidance and planetary protection examples of such conditions to authorizations? What about orbital debris?

   Answer: Yes, the United States may impose conditions on its authorizations that exceed the minimum requirements of the Treaty. In my opinion, requirements for collision avoidance, planetary protection and orbital debris could be conditions for an authorization.

   More important than the question of the power of the US to impose such requirements are the ancillary questions about whether or how to exercise such power: (1) do we know enough to formulate such requirements without harming the development of new commercial space activities; (2) would the requirements impose unnecessary burdens on industry; and (3) will such requirements favor or handicap US companies in international

economic competition; and (4) which requirements are essential to protect national security interests keeping in mind that technical and economic innovation are a key component of national security.

As you know, requirements for deorbiting space objects are imposed by the FCC, NOAA and the FAA on satellite operators. However, the fact that these requirements are all slightly different and may require three separate applications and processing should be instructive and cautionary.

6. How can we use a mission authorization process to address the growing orbital debris problem?
Answer: There is considerable risk to U.S. industry of adopting unilateral conditions to address the problem of orbital debris. Clearly, the U.S. is not the only contributor to the problem and the solution must involve all users of the orbits of the Earth. However, attempting to achieve a multilateral agreement on a satisfactory solution may not be in the interest of the United States. One possible solution is to establish State practice by adopting unilateral measures and then entering into agreements with other nations on a bilateral or limited multi-lateral basis to adopt the same or similar practices. Some teeth could be put into this process by requiring that an agreement on orbital debris mitigation be required between the United States and the launching State(s) as a condition of any mission authorization and as a condition of any export license involving launch from a country other than the United States.

7. Is there validity to the argument that regulations or licensing for mission authorization could drive U.S. companies to "set up shop" in other countries? If so, what is the basis for that argument and how can Congress ensure that a regulatory framework would not lead to such a result?
Answer: At the risk of being accused of giving a "lawyer-like" response, it depends on how the regulations or licensing for mission authorization are implemented. If the process is lengthy or difficult, if the cost in time or resources is high, or the process is unpredictable, then companies can be expected to consider flags of convenience. Congress can mitigate this risk by ensuring a "regulatory light" process in which the requirements for authorization are clear and objective, that there is accountability and that there is a presumption of approval.

Responses by Dr. Henry B. Hogue

Congressional Research Service
Informing the legislative debate since 1914

MEMORANDUM April 3, 2017

To: House Committee on Science, Space, and Technology Subcommittee on Space
Attention: Representative Andy Biggs

From: Henry B. Hogue, Specialist in American National Government, 7-0642

Subject: **Subcommittee Hearing, "Regulating Space: Innovation, Liberty, and International Obligations": Response to Question for the Record**

This memorandum responds to the question you submitted for the record following the recent subcommittee hearing, on March 8, 2017, for which I provided testimony ("Regulating Space: Innovation, Liberty, and International Obligations"). The question replicates the question you asked of me during the hearing and for which I indicated I would follow up later with a response. The question is reprinted below and is followed by the response.

QUESTION: **You talked specifically about non-governmental organizations that regulate certain conduct and activities such as the International Antarctic Trade Organization and FINRA. My question for you is, can you describe whether those have been successful in achieving their organizational ends?**

RESPONSE: CRS has not independently evaluated the success of the International Association of Antarctica Tour Operators (IAATO) or the Financial Industry Regulatory Authority (FINRA) in achieving their organizational ends, so we are not able to provide an authoritative answer to your question based on our own research.

Evaluating the success of these entities in achieving their organizational ends would require defining these ends and identifying objective methods to assess what would constitute success in each instance. Each of these steps might be taken in different ways, depending on the purpose of the evaluation. For example, the objective ends of the IAATO might be defined as the set of ten objectives delineated in its bylaws[1] and summarized as "facilitating appropriate, safe and environmentally sound private-sector travel to the Antarctic."[2] Success in meeting these organizational ends might be assessed by measuring IAATO's attainment of each of the ten objectives. On the other hand, the organizational ends might be defined more broadly as the maintenance of pristine environmental conditions, free from visible human impact. In this case, evaluation of these conditions might be used to assess changes, if any, over time. A further complication in evaluating organizational success may arise if there are trade-offs among the objectives. For example, pursuit of one objective (e.g., quality) may come at the price of reduced performance in

[1] Available at https://iaato.org/bylaws.

[2] https://iaato.org/objectives.

another objective (cost). A more difficult issue arises if different stakeholders for IAATO define success in different ways, or if they have different views about the relative weighting of some objectives over others.

In response to this question, CRS conducted a search for independent evaluative studies of success for each of the two entities. In general, the search did not identify studies of either organization that clearly identified organizational ends and an assessment of the success of the organization in attaining those ends. The search did, however, identify related research that might be of interest to you, and we briefly summarize it here. This summary is intended to be illustrative of the related literature that was identified, rather than a comprehensive portrayal of the ongoing public policy discussion in these areas.

With regard to IAATO, the identified related research appears to address two questions. First, does tourism in the Antarctic promote public awareness of the Antarctic ecosystems and public action on related conservation issues? Second, if so, does this awareness and action outweigh the impact of this tourism on this environment?

One related study published in 2008 suggests that Antarctica tour operators "have the potential to be effective in providing tourist experiences that educate the public and raise awareness of issues facing Antarctica." The study also found, however, that "influencing the actual behaviours of Antarctic tourists, even if they are motivated to adhere to guidelines and to support conservation, can be a difficult task."[3] The study recognizes IAATO as a significant source of industry guidelines for area tourism. It also notes the organization's objectives to "enhance public awareness and concern for the conservation of the Antarctic environment and associated ecosystems' and to "create a corps of ambassadors for the continued protection of Antarctica by offering the opportunity to experience the continent first hand."[4]

A second related study pertained to a potential paradox between seeking to enhance attitudes about environmental protection through a method, Antarctic cruise tourism, that, itself, adversely affects the environment. The study explored the impact of participation in an Antarctic cruise on awareness of, and attitudes about, climate change and found no support for a hypothesis that such tourists would have a higher level of awareness about climate change than average citizens. At the same time, it found that "cruises in general, and Antarctic cruises in particular, produced above-average contributions to climate change, per trip, per capita and per day, by comparison with other international trips."[5]

With regard to FINRA, two related articles were reviewed. The two papers appear to view organizational success as being, in part, a function of the processes through which an institution operates. The first of these is a 2013 law review article that argues that some "self-regulatory organizations" (SROs) like FINRA have become less self-regulatory and more quasi-governmental in nature. In a self-regulatory context, "[i]ndustry professionals have strong incentives to police their own, since many of the costs of misbehavior are born by all member of the profession while the benefits inure only to the misbehaving few."[6] The authors argue that, as organizations move away from the self-regulatory model, such a regulatory arrangement can lose some of its perceived benefits, including direct access to industry expertise, familiarity and trust between the regulating and the regulated, and efficiency in enforcement operations born of understanding how the system actually works. The authors also argue that a diminished use of the SRO model, generally, limits the toolkit available for calibrating a regulatory response to the magnitude and scope of the potential infraction (e.g., parking enforcement and hostile domestic scenarios require different kinds of enforcement). To the extent that such organizations become more governmental,

[3] Robert B. Powell, Stephen R. Kellert, and Sam H. Ham, "Antarctic Tourists: Ambassadors or Consumers?" *Polar Record*, vol. 44 (2008), p. 239.

[4] Ibid., p. 234. The article quotes from IAATO's set of objectives, currently available at https://iaato.org/objectives.

[5] Eke Eijgelaar, Carla Thaper, and Paul Peeters, "Antarctic Cruise Tourism: the Paradox of Ambassadorship, 'Last Chance Tourism' and Greenhouse Gas Emissions," *Journal of Sustainable Tourism*, vol. 18 (2010), p. 347.

[6] William A. Birdthistle and M. Todd Henderson, "Becoming a Fifth Branch," *Cornell Law Review*, vol. 99 (2013), p. 8.

it is argued, the organizations should be subject to "constitutional mechanisms that ensure liberty in our political system,"[7] as would be the case for a purely governmental regulator. These might include, for example, due process rights characteristic of government enforcement actions.[8] The authors suggest that the inclusion of such mechanisms, though perhaps warranted as an organization becomes more governmental, could also "prove counterproductive to the SROs."[9]

A second related paper published in 2017 offers arguments similar to those made in the article above. In its assessment, FINRA is neither a true SRO nor a government agency.[10] As such, the authors suggest FINRA does not have the potential benefits of a true SRO, such as those discussed above. Nor is FINRA "subject to any of the normal transparency, regulatory review, or due-process protections normally associated with government."[11] The paper further notes that "when dealing with FINRA, the many protections afforded to the public when dealing with the government are unavailable, and the recourse that one would normally have when dealing with a private party—both access to the courts and the ability to decline to do business—is also unavailable."[12] The paper further argues that "FINRA is not adequately accountable to Congress, to the public, or to those it regulates."[13] The paper's recommendations include changes intended to increase transparency, provide for recourse, ensure due process, and provide for increased accountability and oversight.

Other related work concerning the relationship between the Securities and Exchange Commission (SEC) and FINRA has been published by the Government Accountability Office (GAO). As I noted in my testimony, the SEC has statutory oversight responsibilities with regard to FINRA's regulatory activities. The SEC's performance as a FINRA overseer is, in turn, the subject of ongoing evaluation by GAO, as required by the Dodd-Frank Act. GAO reports issued in 2012 and 2015 found that the SEC could improve its oversight program of FINRA.[14] Specifically, the 2015 report found that the SEC's "FINRA oversight program continue[d] to lack specific performance goals and measures, documented procedures for certain processes, and an assessment of internal risks to the program."[15]

[7] Ibid., p. 60.

[8] Other scholars have studied similar potential tradeoffs between results-oriented approaches to implementing government programs, which often involve reducing or eliminating perceived "red-tape" procedural requirements, and democratic-constitutional values, such as representation, participation, transparency, and individual rights. See Suzanne J. Piotrowski and David H. Rosenbloom, "Nonmission-Based Values in Results-Oriented Public Management: The Case of Freedom of Information," *Public Administration Review*, vol. 62, no. 6 (November/December 2002), p. 643.

[9] Birdthistle and Henderson, p. 61.

[10] David R. Burton, *Reforming FINRA*, The Heritage Foundation, Backgrounder, Washington, DC, February 1, 2017, http://www.heritage.org/markets-and-finance/report/reforming-finra.

[11] Ibid., p. 2.

[12] Ibid., p. 3.

[13] Ibid., p. 5.

[14] See GAO-12-625, *Securities Regulation: Opportunities Exist to Improve SEC's Oversight of the Financial Industry Regulatory Authority*, May 30, 2012; and GAO-15-376, *Securities Regulation: SEC Can Further Enhance Its Oversight Program of FINRA*, April 30, 2015.

[15] GAO-15-376, p. 29.

Appendix II

Additional Material for the Record

DOCUMENTS SUBMITTED BY SUBCOMMITTEE
CHAIRMAN BRIAN BABIN

The Heritage Foundation
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March 7, 2017

The Honorable Lamar Smith
Chairman
House Committee on Science, Space and Technology
2321 Rayburn House Office Building
Washington, DC, 20515

Dear Chairman Smith:

The following statement is submitted with regards to the hearing scheduled for March 8, 2017, "Regulating Space: Innovation, Liberty, and International Obligations," and in response to a request to discuss possible "legal warfare" dangers that might arise from excessive regulation.

For the last several years, there have been calls for the United States to pursue an "international code of conduct" or "rules of the road" regarding space activities. The nominal objectives of such a code would be to establish "common sense standards for debris limitation, launch notification, on-orbit monitoring, and collision avoidance."[1] The purpose is to "stem the rise of uncontrollable debris, add demonstratively to spaceflight safety, and clearly differentiate those who use space responsibly from those who do not."[2]

The problem is that the creation of such a code would not necessarily influence key competitors and potential adversaries, who see space first and foremost as a strategic domain that must be controlled. Worse, by extending such a code into the realm of regulatory oversight, it would open the way to legal warfare or "lawfare" measures, undermining American security and competitiveness while doing little to constrain those same competitors and adversaries.

It is essential to note that even advocates of the various iterations of the code of conduct acknowledge that the United States itself already follows the various common sense standards and best practices. So, American companies do not require a code, or an additional set of regulations, to already operate in a responsible manner.

By contrast, certain other states, especially the People's Republic of China (PRC) are unlikely to be moved to adopt this code of conduct, given their own interests. These include, in the first place, being able to secure their own strategic position in space. This goal is reiterated in the most recent Chinese space white paper, "China's Space Activities in 2016," which enunciates the vision of building China "into a space power in all respects."[3] The PRC has made major investments in all aspects of its space capabilities, including space launch, satellite development, anti-satellite and counter-space forces, as well as satellite applications.

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[1]Douglas Loverro, testimony before Senate Armed Services Committee, Strategic Forces Subcommittee (March 12, 2014), http://www.armed-services.senate.gov/imo/media/doc/Loverro_03-12-14.pdf (accessed March 6, 2017).
[2]Ibid.
[3]State Council Information Office, People's Republic of China, *China's Space Activities in 2016*, December 2016, http://news.xinhuanet.com/english/china/2016-12/27/c_135935416.htm (accessed March 6, 2017).

As important, the PRC has demonstrated a great interest in developing its commercial space industries, including the sale of satellites to a variety of customers ranging from Venezuela to Bolivia to Nigeria. It has succeeded in doing so in part because its state-owned aerospace industries are able to provide a "soup to nuts" set of services from satellite design to launch services to launch insurance at lower prices than comparable Western companies. The space white paper indicates that the PRC government will emphasize expanding China's commercial space activities. Its competitive edge would only be heightened if American companies had to add another layer of regulatory oversight and compliance.

For the Chinese government, one means of assuring its strategic advantage in space is the employment of "legal warfare," a form of political warfare, against both commercial and national competitors. As Chinese authors note, legal warfare, at its most basic, involves "arguing that one's own side is obeying the law, criticizing the other side for violating the law, and making arguments for one's own side in cases where there are also violations of the law."[4] The instruments of legal warfare include not only national laws, but the full range of legal instruments, including

> legislation, law enforcement, judicial law, as well as policy consultation, legal pronouncements/propaganda, legal education, and other such techniques to undertake a series of legal conflict activities.[5]

In short, Chinese concepts of legal warfare employ various means, including both laws and regulations, in order to gain an advantage. While this is typically associated with military and strategic advantage, the PRC's willingness to employ military capabilities in order to support its commercial operations, such as through cyber economic espionage, underscores that Beijing does not necessarily see a distinction between military support to its commercial players and military activities in pursuit of strategic gain. Indeed, given the dual-use nature of space, the PRC is likely to view any foreign space entity, government or commercial, as a potential threat.

Consequently, the likelihood of Chinese adherence or adoption of a space-related code of conduct is unlikely at best. Nor does China appear amenable to being "shamed" into adhering to other countries' best practices. Instead, Chinese behavior in other domains, such as the maritime realm, illustrates China's attitude towards non-binding codes of conduct.

Despite the creation of the U.S.–China Military Maritime Consultative Agreement (MMCA) in 1998 and the 2014 Code for Unplanned Encounters at Sea (CUES) in 2014, China has continued to operate in a dangerous manner around US ships and aircraft engaged in surveillance and reconnaissance operations in the western Pacific.[6] Similarly, China's ratification of the UN

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[4]Han Yanrong, "Legal Warfare: Military Legal Work's High Ground: An Interview with Chinese Politics and Law University Military Legal Research Center Special Researcher Xun Dandong," *Legal Daily* (PRC), February 12, 2006.

[5]Wang Mei, "Research on Several Issues of Legal Warfare," *National Defense University Newspaper*, No. 7 (2004), p. 66. Cited in Song Yunxia, *Legal Warfare Under Informationalized Conditions* (Beijing, PRC: AMS Publishing, 2007).

[6]For two recent examples among many, see Tom Vandenbrook, "Chinese Fighters Buzz Navy Patrol Plane," *USA Today*, May 18, 2016, http://www.usatoday.com/story/news/world/2016/05/18/chinese-fighters-buzz-navy-patrol-plane/84560640/ (accessed March 6, 2017), and Jane Perlez, "US Accuses Chinese Jet of Flying Too Close to American Plane," *The New York Times*, June 8, 2016, https://www.nytimes.com/2016/06/09/world/asia/us-china-military-jet-intercept.html?_r=0 (accessed March 6, 2017).

Convention on the Law of the Sea (UNCLOS) did not lead to their submitting to binding arbitration when the Philippines (another UNCLOS member) sought to resolve their maritime disputes in the Spratlys. Given the emphasis placed on the space domain, it is not clear why the creation of the code, or its incorporation into American regulations, would lead Beijing to follow them.

What the PRC *is* likely to do, however, if the United States were to incorporate the provisions of a code of conduct into its regulations would be to argue, whether directly or through surrogates, that any failure to comply with said regulations was tantamount to irresponsible behavior and threatening to other spacefaring states. Just as commercial companies find it hard to defend themselves against nation-state actors intent upon cyber economic espionage, American commercial space companies would likely find that their activities were being scrutinized by foreign nation-states' legal warfare efforts to demand absolute compliance with American regulations.

At a minimum, such efforts could generate major additional costs as companies had to engage in defensive legal measures. But this would be exacerbated by the public relations cost that would emerge—further compounded by the Chinese state-owned media's ability to transmit its message (as part of public opinion warfare, another component of the Chinese political warfare arsenal). For smaller companies, and especially start-ups with limited resources, this is likely to prove prohibitive. It may also discourage venture capital from investing in such companies in the first place. In either case, the publication relations cost would further enhance the competitiveness of China's own space industries.

In conclusion, the incorporation of elements of the proposed "rules of the road" or "international code of conduct" for space into the American regulatory framework only serves to provide potential competitors and adversaries with an easy means of undermining new commercial entrants into the space arena.

Respectfully,

Dean B. Cheng

Dean Cheng
Senior Research Fellow, Asian Studies Center
The Heritage Foundation

Letter for the Record to Members of the Subcommittee on Space (Committee on Science, Space, and Technology)

Clyde Wayne Crews Jr.
Vice President for Policy/Director of Technology Studies
Competitive Enterprise Institute

Prepared for the hearing:
Regulating Space: Innovation, Liberty, and International Obligations

U.S. House of Representatives
2318 Rayburn House Office Building
Washington, D.C. 20515

Wednesday, March 8, 2017
10:00 AM

- **Introduction: Making Space for Free Enterprise**
- **Context: "Authorization and Supervision" of Private Commercial Space Activity**
- **Solution In Brief: A Presumption of Authorization for Commercial Space Activities Without New Legislation**
- **Space Commercialization Within the Broader Regulatory Liberalization Agenda**
- **Hazard and Risk Reduction: Traffic Management, Space Situational Awareness and More**
- **The Takeaway: Why the Federal Aviation Administration et al. Cannot Provide Light-Touch Mission Authorization**
- **Conclusion: Disruptive Technologies Versus Disruptive Washington**

The Competitive Enterprise Institute (CEI) is a non-profit public policy research organization dedicated to individual liberty, limited government, and free enterprise. We appreciate the opportunity to discuss vital policy issues surrounding innovation in commercial space activities. My written Letter for the Record follows.

Introduction: Making Space for Free Enterprise

There's more technology in an iPhone than the U.S. air-traffic control system.[1]
—Wall Street Journal

In many if not most federal regulatory regimes, were we starting with a blank sheet of paper, we would not maintain the same authorities in place today.

So when liberalizing a heavily regulated segment of a mixed economy, or protecting an emergent sector like the commercialization of outer space from regulatory and political ambitions, the gauge of impending reform's appropriateness is simple: *The body of private activity subject to future regulation must decline rather than increase*. The de-escalation of central power is the essence of agency *expertise*, rather than the administrative state's century long premise that expertise consists in a priestly, guiding hand from above.[2] Commercial and hazard-reducing expertise are distributed globally. Further, rare are the instances in which agency licensing processes move rapidly enough for modern commerce, as we will review.

One hears deserved praise of "permissionless innovation,"[3] the case for a light regulatory touch and a rejection of over-precaution. But there exists too little vocabulary among 21st century policymakers for legitimizing large-scale or complex free enterprise, for articulating the reasons for casting off entrenched administrators. This vacuum and the negative initial conditions being created has diminished the prospects for light touch regulation, threatening to paint us into a hyper-regulatory corner even as the "Final Frontier" awaits.[4] That will cost tomorrow's economy trillions.[5]

The public probably has little idea how much regulators intend to crack down on the commercialization of space. A substantial problem for the space sector today is that laissez-faire did not happen automatically for earthbound heavy industries and technologies after our industrial revolution, and *still* hasn't materialized for them. The "smokestack" stage of industrial free enterprise brought the contemporaneous public utility era, which created artificial regulatory monopolies against which competition was outlawed (deemed "natural" monopoly), and the progressive era "rule by experts" of regulatory bureaucracies.

The further failure to extend liberal economic institutions of complex property rights, contract and risk management into infrastructure, airsheds, watersheds, spectrum, roads, or even to take the obvious 21st century step of kick-starting the privatization of ordinary commercial flight airspace,[6] stands to derail the open-ended potential of commercial space activity. These realms remain largely controlled by governments; such laws as the Antiquities Act govern still more, as do such international agreements as the Law of the Sea Treaty.[7]

Given this precedent and context, for commercialized space (and alas, for other sectors) we need a regulatory heatshield, a HOT Act ("Hands Off Technology"). We require better and soundly defended private and collaborative institutions to replace 19th and 20th century central bureaucratic oversight of private endeavors that, in fact, should largely be let alone. Congress should eliminate agencies as it once promised in the Contract With America era, or at least pass Article I-enshrining legislation, such as requirements for votes on costly agency rules. If the 115th Congress does neither, it should at minimum prohibit agencies from issuing new rules and guidance regarding *frontier* technologies where (1) Congress has not enacted law to authorize (such as Internet "net neutrality") or (2) has enacted law prematurely given the vocabulary problems noted and inadvertently yielded power to the administrative state (autonomous drones, space).

Sectors like commercial space, networked communications technology, robotics, autonomous vehicles and exo-transportation (cars, airborne drones and low-earth orbit) stand on the threshold of inextricably snug, irreversible regulation at precisely the time these very technologies eliminate the "market failures" that rationalized old-school regulation of safety, the "commons" and other features in the first place. The primary engines for these threats to the tech sector are the thousands of pre-existing regulators and their constituents, whose once-convincing justifications for their supposed impartial oversight no longer apply (allowing that they ever, properly, did).

The other threat is cronyism, from government funding of science and technology that widely displaces private funding,[8] to billionaires with hands outstretched for federal subsidies and favors[9] to assuring NASA first dibs.[10] It is not prudent to expect such individuals or entities to be advocates of laissez-faire. A corollary for permissionless innovation is the presupposition that one innovates, not that extract others' resources or political favor. Other citizens have aspirations of their own that may not involve paying for battery research technology, the HyperLoop or a trip to Mars. Recipients pay for subsidies by accepting regulation in exchange. That makes the subsidy in one sense a mere wealth transfer, rather than the innovation-enhancing boost it seems. This that doesn't just hurt recipients and their industry, even if they don't see it; it impacts all of society. Cronyism's impacts can be particularly severe in frontier sectors like commercial space development where entire industry structures are being upended and the role of the regulator and perhaps even some incumbent firms require total reassessment. Technology pulls America's economic wagon, but the wrong interventions can mean stagnation that propagates for decades, doing even century-long damage as when competition outlawed in the communications and electricity sectors and government-granted monopolies affirmed instead.

In technology, market liberal institutions are too easily pre-empted by the bureaucratic impulse to expand and create "public good" or "public utility" centrally managed models for everything big and new and game-changing. Drone and self-driving car policies are at grave risk of morphing into 21st century versions of 19th-century public-utility style regulation. The reason? Since roads already are primarily government-owned, and airspace government-controlled, we can be certain that policymakers are not pondering liberalizing alternatives that reduce their power, such as a wealth-creating extension of private property rights into airspaces. We'll cover the implications of this for commercial space development shortly.

Many regulatory steps will be backward; others will veer into a cul-de-sac inducing an incalculable reduction in frontier production possibilities, wealth expansion, well-being and advancements in safety. This Letter for the Record is a call for making explicit the benefits of the principle, while conforming to international treaty obligations, of *separation of technology and state* in the commercial space sector. It seeks to provide some of the initial vocabulary needed to legitimize keeping distortion-inducing regulation off the entrepreneurial frontier. Regulation in advanced technology beyond the absolute minimum necessary is worse than government merely picking winners and losers (governments pick only losers); regulation effectively *chooses among business models as such*, imposing rigid frameworks on all. (examples include the allegedly "open" Internet; antitrust regulatory reconfigurations; government controlled airspaces). Today's technologies make the stakes immensely higher than in previous eras.

Context: "Authorization and Supervision" of Private Commercial Space Activity

The future of the commercial space regulatory regime now appears to have been made to hinge largely on certain directive to the Office of Scicnce and Technology Policy (OSTP) contained in the 2015 U.S. Commercial Space Launch Competitiveness Act's (CSLCA) Section 108 ("Space Authority").[11] Based upon the Barack Obama administration's identification of "appropriate authorization and supervision authorities" for "current, and proposed near-term, commercial non-governmental activities conducted in space," it was then directed by the Congress to develop and recommend "an authorization and supervision approach that would prioritize safety, utilize existing authorities, minimize burdens to the industry, promote the U.S. commercial space sector, and meet the United States' obligations under international treaties."

This private-sector authorization and supervision language descends from the Outer Space Treaty of 1967,[12] (50 years old this year) Article VI of which specifies:

> *The activities of non- governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty.*

This formulation represented 1967's cold war era anticipation of private commercial activity in space, and directed governments to oversee private "activities," keep weapons out of space, keep the peace, and (elsewhere in the treaty) restrain certain ambition such as sovereignty claims. The modern disagreement is over how much or how little regulation is needed to constitute "authorization" and "supervision." The implications are enormous. For one example, PL 114-90's Section 51302 provisions on mining and ownership and sale of resources provisions ("exploration for and commercial recovery of space resources") authorized in the CSLCA, which would be the most obvious and elemental operations on celestial bodies beyond basic roaming, are already regarded by some as a violation of the Outer Space Treaty, in the form of an illegal assertion of sovereignty.[13] Section 51303, on "Asteroid resource and space resource rights," holds that:

> *A United States citizen engaged in commercial recovery of an asteroid resource or a space resource under this chapter shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource obtained in accordance with applicable law, including the international obligations of the United States.*

There are either eight or nine planets in the Solar System depending upon who's counting and their sympathies toward Pluto, along with at least 146 moons,[14] nearly 2 million asteroids larger than a kilometer,[15] and millions of smaller ones. So a bit more liberal interpretation of "sovereignty" will be in the interests of all space-faring nations, one can assert confidently.

OSTP's letter in fulfillment of April 4, 2016 to House Science, Space, and Technology Committee Chairman Lamar Smith (R-Texas) and Senate Committee on Commerce, Science, and Transportation Chairman John Thune (R-South Dakota) contained a "Mission Authorization Proposal" in the appendix which, ominously, took "months of consultations among Federal

departments and agencies and with the commercial space industry."[16] Further, new paperwork burdens in the form of a "Registry" would be created for "the holder of a Mission Authorization to provide updated information both on a periodic basis, and whenever the holder of the authorization experiences a material change to operations that would affect the affirmations and information that were originally submitted in support of the authorization." Whatever counts as a "material" change would trigger the attention of numerous agencies to reauthorize again.

Existing space-related operations, already regulated by numerous agencies and not implicated in the proposed Mission Authorization, include, as, the Section 108 report to Thune and Smith put it, launcher services, satellite communications and remote sensing,

The OSTP's Section 108 report emphasized instead "newly contemplated commercial space activities," which the Administration gauged as "Private Missions Beyond Earth's Orbit," "New On-Orbit Activities," and "Space Resource Utilization." The Mission Authorization would have the Federal Aviation Administration "coordinate an interagency process in which designated agencies would review a proposed mission in relation to specified government interests." These would include the Secretary of Transportation (via the Federal Aviation Administration), the Secretary of Defense, the Secretary of State, the Secretary of Commerce (National Oceanic and Atmospheric Administration), the NASA Administrator, the Director of National Intelligence, "and such other appropriate United States Government departments and agencies." Recent moves to legislate this overly complex coordination would enable the Federal Aviation Administration's (FAA) Office of Commercial Space Transportation (AST) to govern these functions.[17] AST regulates launch and re-entry now, but not activities in outer space.[18] There exist alternatives to such agency licensing constraints and an opportunity to reorient.

Solution In Brief: A Presumption of Authorization for Commercial Space Activities Without New Legislation

The "Mission Authorization Proposal" was not issued in a policy/intellectual vacuum. It was, rather, contemporaneous with a mindset wherein former president Obama and his administration demonstrated preferences for federal oversight of a great amount of private scientific and technological activity, including "manufacturing hubs"[19]; purported "net neutrality" for the Internet[20]; a "National Broadband Plan"[21]; an "Internet of Things" privacy policy[22]; and govenance schemes for artificial intelligence and high-technology generally.[23] Better, however, to leave such ill-advised, wealth-reducing and risky "national" policies to other nations.[24]

There exists a well-intended legislative proposal to flesh out the permitting process of the CSLCA and the FAA Mission Authorization Proposal and become space-faring asteroid miners sooner rather than later.[25] Here, however, we echo the recommendations of commentators and experts who instead recognize the legitimacy with respect to the Outer Space Treaty and CSLCA of blanket rather than one-by-one approvals for every mission. Reasons will become even clearer when we look shortly at FAA's track record with respect to governing related edge technologies. Rep. Brian Babin (R-Texas), chairman of the Subcommittee on Space of the House Committee on Science, Space and Technology, has, in numerous comments before stakeholders including industry and government, cited a presumption that commercial space activities are effectively authorized.[26] Babin said to the Commercial Spaceflight Federation: [27]

> *[T]he government's role isn't to give you permission to do something. The government's role should be limited to only those areas that require its intrusion, which is a high bar. The burden of proof shouldn't be on the individual to demonstrate the "right" to act; the burden of proof should be on the state when it seeks to restrict liberty. This isn't simply a philosophical question; it is also a question of economics" [with respect to the competitive global environment and space-faring activities of other nations].*

The OSTP letter itself notes that, with respect to authorization and supervision, "Many space-faring States discharge this treaty obligation through a more general licensing framework for non-governmental space activities," while in contrast the U.S. utilizes "separate frameworks" for various aspects of launch, and spaceflight reentry, and communications.[28] There is leeway for this man-made set of circumstances to break toward more liberalization.

Babin's permissionless-innovation approach is echoed by the Mercatus Center at George Mason University, which observed in a November 2016 comment to Rep. Lamar Smith (R-Texas), Chairman of the Committee on Science, Space, and Technology, that the "nature of the authorization and supervision required by the treaty are not specified. Each State Party to the treaty may decide what constitutes appropriate authorization and continuing supervision of its national nongovernmental entities."[29] And, further, in a section on "Blanket Authorization and Alternatives to Regulatory Supervision," that "Congress has sole authority and complete discretion to decide what, if any, authorization and supervision it would like to require," and that "Congress is within its rights to authorize all nongovernmental activities in space on a blanket basis" while still ensuring objectives such as non-interference with peaceful activities by other States. In other words, a regulatory framework, expecially a complex, multi-party one like that contained in the FAA Mission Authorization Proposal is not necessary.

As former FAA attorney Laura Montgomery's work indicates, it is folly to create an environment where every move in space requires authorization and supervision.[30] The OST notes *activities* (plural), not that any and every particular activity requires specific authorization, which quickly descends into impossibility in both the real world and outer space. The CSLCA simply instructed the administration to "recommend an authorization approach." That can be liberally interpreted. As we'll see shortly, different technology industries and sectors cross-fertilize one another, to the benefit of commercial space activity. Sometimes new stones don't get turned over until complementary and prerequisite discoveries are made, which halt-inducing regulation can derail. Propeller research had to happen before the Wright Flyer could lift off under power.

When it comes to treaty and statutory obligations, we nonetheless can (and competitor nations surely will) aggressively interpret "authorization," and light-handedly interpret "supervision." Part of long-term planning and federal agency "expertise," echoing our introduction to this Letter, will consist of being prepared, while showing these clauses do not require regulation. Even if restrictions and regulatory hindrances did exist, as they do with the legacy launch, communications and sensing services not part of Mission Authorization, Congress should move forward with a stance of reducing them.

Space Commercialization Within the Broader Regulatory Liberalization Agenda

It is hardly a surprise that administrative agencies wish to retain authority over emerging sectors; we don't even grow sugar and produce milk without big government programs.[31] So frontier sectors stand little chance of enjoying relative laissez-faire without conscious, aggressive initiative and guardianship on the part of policymakers; and too few are doing that. The large regulatory and fiscal state, which issues thousands of regulations annually,[32] as well of thousands of guidance documents and other manifestations of "regulatory dark matter"[33] implicates not just commercial space and other frontier sciences but many legacy industries too.

A broader regulatory reform agenda is taking place in the new Donald Trump administration, which issued a series of executive actions such as temporary regulatory holds, and procedures for eliminating two rules when a new rule is adopted.[34] Meanwhile the 115th Congress passed several regulatory liberalization measures in its first weeks. Though he has shown a worrisome inclination toward spending stimulus in the form of infrastructure,[35] Trump should avoid seducing the tech sector with federal "help" through federal subsidies, favors and piloting in the vein of President Obama's above-noted manufacturing hubs. The model of the modern administration state model should yield to congressional accountability, such that loosely or non-accountable bureaucracies extend no rules to new technologies without explicit acts of Congress (and these too should be avoided if possible).

The yet-to-be-regulated technology frontier should be left that way, with the president and Congress maintaining a presumption against economic regulation and agency mission creep in areas like commercial space and technology generally. Sound principles noted with respect to Internet policy apply broadly too, and include (1) do no harm; (2) be patient; and (3) embrace change:[36]

> *Rather than impose administrative rules, policymakers should respect private property rights; unhindered freedom of contract; voluntary negotiations and standard-setting; private dispute resolution; other common law standards such as the law of trespass and torts; and the proper interpretation of the Commerce Clause of the Constitution as a guarantor of the free flow of interstate commerce.*

Modern over-regulation stems not solely from agency overreach, but from over-delegation by Congress, an issue tackled in a series of 2016 congressional task force reports providing numerous suggestions to reinstate the principles of separation of powers and checks and balances.[37] The president and Congress should maintain a general predisposition toward avoiding legislation and regulation in technology sectors, eliminating and/or rolling back agencies and programs, and rejecting new sectoral regulation by any agency until Congress votes to explicitly authorize it.[38]

In conjunction with regulatory liberalization, there is an increasing interest in expediting roads, bridges, plants, and critical infrastructure, of which space-related assets will increasingly be a part. The nation has cycled through government canals and national roads that failed or were overtaken by the new,[39] and now contends with the likes of a national capitol Metrorail system with budget shortfalls, rising costs and low ridership,[40] and modern crumbling infrastructures including sewer systems that can't handle flushable diaper wipes[41] (the government knee-jerk

response to the latter? Ban the wipes.[42]). The Obama administration had claimed drinking water and wastewater infrastructure require $600 billion in improvements over 20 years.[43] The market should steer, not just row.

Commercial space activity authorizations of the 21st century will, alas, inevitably involve government partnerships given today's mode of operation, but should avoid governmental mismanagement that is now the rule. Also, the acknowledged headaches and delays of routine terrestrial permitting need changing,[44] and the president has issued directives intended to speed up projects and remove impediments imposed by regulatory agencies.[45]

The case for separation of technology and state needs a hearing, and the current environment of rethinking regulation sets the tone for a cornucopian rather than precautionary view of commercial space activities. Naturally, policy uncertainty affects firms and sometimes leads to unwise-in-hindsight calls for guidance. But in important respects, today it is the *certainty* of regulation that drives costs skyward and hurts innovation.[46] The FAA's Mission Authorization Proposal will send uncertainty into orbit, as we will see.

Hazard and Risk Reduction: Traffic Management, Space Situational Awareness and More

> *From the Fall from Grace to the fall of Enron, it has always been with us. It has been the primary reason that man is so often trapped into fatalistic acceptance of poverty and ignorance. And once mankind accepted the Promethean challenge to improve his condition, the issue of how best to deal with it has been a central element of controversy. Should the elites control it centrally, or should individuals deal with it directly? And when the unpleasant aspects of it occur, should we retreat or evolve institutions to make future mishaps less likely? In any event, it involves degrees of uncertainty and, invariably, an element of danger; therefore, it must be addressed in a balanced and careful fashion. Progress—civilization itself—may be seen as the gradual evolution of institutions that manage it.*
> It *is risk—the possibility that a desired event will not occur or that a feared outcome will.*[47]
>
> —Fred L. Smith Jr., Founder, Competitive Enterprise Institute

Before looking at the regulatory thicket that will be created by the Mission Authorization Proposal, it is helpful to address the question of hazards, for these risks are what prompt most calls for tight regulatory oversight. In its normal evolution, technology can reduce the scope of "market failure" and the subject matter for top-down regulation, including that of risk management, even in space.[48] Along with compliance with assessing the OST's authorization and supervision requirements, the CSLCA directed the Administration to report on matters such as orbital traffic management, space situational awareness and related matters.

But not everything under the sun—or between here and the asteroid belt—is best turned into a public policy question, or a regulatory agency. Policymakers should keep uppermost in mind that matters they presume to *regulate*—public health, financial stability, privacy, and in the present instance, safety in outer space—are not just dependent variables subject to Washington's easy

manipulation. These features are forms of *wealth*, and aggressive competitive disciplines, not just bureaucratic ones, are necessary to advance them.

The market discovery process, that is, increasingly enables not just wealth creation, but fairness and democratized access, choice, consumer protection, and safety and fitness for use. The regulatory state, utility-style regulation and the Administrative Procedure Act are increasingly inadequate means of managing risk and imposing discipline in a market economy. Technology, luckily, exposes prior and ongoing regulatory malpractice. Contractual mechanisms, insurance markets, waivers, and liability innovations that mitigate risk become easier, not harder, alongside technology itself in the normal course of events, if not derailed by regulators or special interests legacies.

Humans traveling in privatized space will lose their lives. And the first to make the trip to Mars may never return, voluntarily so.[49] (I say that as one who favors robotic rather than human space travel beyond the moon but would not interfere with those choosing permanent settlement and cosmic ray baths). But the drive to politically regulate such concerns is not unusual; on a parallel track, some politicians intend to exploit the concerns caused by the rise of artificial intelligence to expand government power.[50]

The more relevant issue with respect to space risk entails hazards to third parties. Government too often indemnifies companies from the harms they cause, and in that sense cannot even pretend to be in the risk-reduction business. Regulators sometimes attempt to "help" favored industries with waivers of liability. Homeland security legislation sought to limit liability for manufacturers of products related to the fight against terrorism, by indemnifying them for losses above insurance levels should their security technologies like weapon alarms and bomb detectors fail in the event of an attack. Relatedly, thanks to the immunity granted by the Price Andersen Act, we have no way of knowing whether nuclear power is viable in a free market. Most pertinent for pondering commercial space activity, one certainly cannot now envision the nuclear power industry's emergence from hyper-regulation. This state of affairs was self-inflicted.

The CSCLA already violates the principle of private risk management in Sec. 103's extension of "Indemnification for Space Flight Participants," to absolve launch providers from catastrophic losses or for injury to third parties (at least through September 2025). The alternative market approach would be private assumption of risk or contracts that limit liability—both of which would impel greater attention to quality control. Ironically removing that indemnification would more easily foster removal of the entire regulatory structure at issue. Every new technology brings risks, but part of the market process is also to develop the risk management institutions that go along with that risk to mitigate it. For example, the sharing economy" (Uber, Airbnb and the like) faces novel liability challenges,[51] but these are not impossible hurdles.

Still, private assumption of governmental traffic and situational risk management are a major topic and great progress is being made. Space Subcommittee Chairman Brian Babin notes the possibility of reaching beyond federally centered directives:[52]

> *The FAA is advocating for taking over existing DoD [Department of Defense] SSA [Space Situational Awareness] responsibilities. They are also calling for expanding the*

number and types of SSA data sources they would process, including commercial sources. The Administration's Section 110 report concludes it is feasible for a civil agency, specifically the Department of Transportation, to take over DoD's function. But neither the Administration's report or the FAA has undertaken an analysis of the broader trade space to determine the pros and cons of non-governmental solutions. Are there viable solutions that are superior and do not involve the FAA or another civil agency taking over DoD responsibilities?

Data collection plays a large potential role in risk management. Despite the ever-present insistence for an FAA/governmental lead on the myriad kinds of data collection, the prospects for and eventual presumption for private risk management can be elevated. Data sharing by entities like the Space Data Association's satellite operators is already prevalent.[53] Here below orbit, technology and tracking could make it possible to pack the sky like a neutron star with commercial and personal drones, with defined corridors respecting rights,[54] if only policy would permit (as we will see, drones are being absorbed into old commercial airspace models instead). Numerous data-awareness and sharing innovations are happening. Routing by algorithm can save lives in airspace and highways by eliminating the human-error hazard.[55] Companies like Uber are collecting vast amounts of locational and traffic data.[56] Amazon has patented a technology to allow self-driving vehicles to navigate reversible lanes.[57] Space-based tracking of commercial airline flights is emergent, gradually eliminating real-time trans-oceanic gaps.[58] We see privately managed drone docking stations and infrastructure.[59] We see Google's "Street View" cars mapping air pollution with chemical sensors, and traffic algorithms taken for granted by commuters,[60] while, ironically, it is the local city planners who would like to thwart the apps, or even create gridlock to drive desperate people into biking or taking public transport.[61]

Data collection with respect to space operations, and related innovations, are ripe and growing, very competitive fields. These ought not be turned into public utility functions when market pricing algorithms and distribution are essential. Here on the ground, "smart highways" and "smart cities" in which governments compel communications technologies' interface with private sector autonomous vehicles will be anything but "smart." Cross-fertilization between the space sector's needs with autonomous vehicles on the ground and air should be abundant. It is interesting that the orbital space debris that has become a concern has happened without a large private sector presence in space. In any event, situational awareness and like services are really alternative ways of talking about property rights emergence in air and space. Transactions costs are coming down, better informational outcomes are emerging, and rationales to regulate or control centrally are declining.

The matters preoccupying FAA seem not to be the actual problems needing resolution at the dawn of a multi-generational space program, but rather seem custom-made to ignore the actual issues that need to be solved for robust airspace and space development. A recent FAA presentation in some instances seems to conflate the industry's "challenges" with FAA's.[62] "Achieving continuous improvement human space flight safety" is not a "challenge" for industry, it's the normal goal and operational mode; they have lives and assets to protect. The industry seems light-years ahead of such thinking. Amazon's Bezos, for example, ambitiously envisions that "all of our heavy industry will be moved off-planet," that "Earth will be zoned residential and light industrial.[63]

Rep. Babin has noted that "The argument that space traffic needs to be managed by the government fails to sufficiently take these ongoing and successful efforts into account"[64] and that "space situational awareness information and services are not an inherently governmental function."[65] We can see this reality cuts across sectors that can learn from one another.

Next, we look at why the prospects for FAA to take a light-handed regulatory approach are not good.

The Takeaway: Why the Federal Aviation Administration et al. Cannot Provide Light-Touch Mission Authorization

> *It is hard to imagine a more stupid or more dangerous way of making decisions than by putting those decisions in the hands of people who pay no price for being wrong.*
>
> —Thomas Sowell

Sometimes, the devil isn't just in the details, but in the premise. What does the Federal Aviation Administration's record indicate about a propensity toward a light touch with regard to commercial space activities? For those actors anticipating that the mission authorization plan will increase regulatory certainty, FAA may have other ideas. Good intentions notwithstanding, the FAA's track record unambiguously shows that it will not be able to coordinate Mission Authorization in a way that doesn't increase regulatory uncertainty.

A recent example is the FAA's track record of the with respect to adopting a live-and-let-live posture with respect to drones, where the agency has shown they're not fully engaged in the business of streamlining regulations at all, but rather expanding them on operation and certification. Early on, there was a 2007 FAA rule interpretation on drones via a Notice of Policy[66] that actually temporarily *outlawed* commercial activity (in violation of the Administrative Procedure Act), before a reversal by the National Transportation Safety Board.[67]

The 2012 FAA Modernization and Reform Act[68] (unwisely in this view) certified FAA authority to regulate drones with its section on "Integration of Civil Unmanned Aircraft Systems Into National Airspace System" (and, like CSLCA, included a Section 332(a) call for a "Comprehensive Plan"[69] complete with mandatory reports and a "roadmap"). In other words, even when presented with the opportunity to take a more hands-off stance with respect to a more "earthbound" (albeit, airborne) set of technologies, the FAA opted for a regulatory approach.

Later in fulfillment came the FAA's June 2016 624-page final rule,[70] "Operation and Certification of Small Unmanned Aircraft Systems," which contained "excessively precautionary approaches,"[71] such as stipulating line-of-sight operational requirements, and a ban on night-time operations among numerous other restrictions—ig noring the ability of technological and contractual solutions to address risk. The agency also refused to stand down to local law enforcement solutions.[72] The final rule also contains declarations from the agency regarding case-by-case waivers and blessings, as well as a large quantity of forthcoming *guidance* (not new laws or new APA-based regulations, but unpredictable guidance), much of which would seem to be economically significant, on issues including:

- Industry best practices;
- Risk assessment;
- Potential guidance on external load operations;
- Guidance associated with not dropping objects in ways that damage persons or property;
- Advisories on training and direction to air traffic control facilities;
- Preflight checks for safe operation;
- Vehicle conditions for safe operations; and
- Guidance "on topics such as aeromedical factors and visual scanning techniques."

Consider, just for one example from this assortment, FAA's conclusion with respect to the seemingly ordinary freedom to operate multiple drones without asking permission:

> *The FAA also acknowledges the benefits of research and development associated with the simultaneous operation of multiple unmanned aircraft and agrees that additional flexibility is called for in this rule so that the agency can administratively allow these types of operations based on operation-specific mitigations. Accordingly, the FAA has made the prohibition on the simultaneous operation of multiple small unmanned aircraft waivable on a case-by-case basis. To obtain a waiver, a person will have to demonstrate that his or her simultaneous operation of more than one small unmanned aircraft can safely be conducted under the terms of a certificate of waiver.*

So one must get a *waiver*. This approach could, air traffic control-style, put us on a path to getting a handful of licensed, dominant operators controlling the likes of the national drone package-delivery market, just as 100 years ago, competitive electricity and communications services were purposely eliminated in favor of monopoly franchises and a perpetual regulatory superstructure to manage it all.

The Mother May I, case-by-case approach continues now in the CSLCA aftermath. If FAA causes drones to fly into a restrictive regulatory black hole, it may be taken as given that the multi-party regulatory process of the Mission Authorization approach to commercial space activities will as well. The industry will be largely governed by guidance, the most uncertain of the uncertain when it comes to regulation. And the agency will be largely unaccountable, shielded by the presence of a regulatory coalition that agrees with it. At this point it would come as no surprise to know that the FAA tried to halt a flight-sharing "Uber" in the air venture.[73]

Other developments in land-based autonomous vehicle operations offer further cautions. In September 2016, the National Highway Traffic Safety Administration's (NHTSA; notably an arm of the Department of Transportation just as the FAA is) issued its Federal Automated Vehicles Policy guidelines "to speed the delivery of an initial regulatory framework and best practices to guide manufacturers and other entities in the safe design, development, testing, and deployment of highly automated vehicles."[74] This guidance offered some worthy proposals in the main, minding, however, the caveat that "NHTSA must work to limit its precautionary impulses, which have the potential to delay and increase the cost of automated vehicle deployment—meaning more preventable crashes, more injuries, and more deaths."[75]

More troublesome is NHTSA's recent foray into certain vehicle-to-vehicle (V2V)

communications standardization mandates,[76] and even vehicle to infrastructure (V2I) guidance newly emergent from the Federal Highway Administration.[77] These are some of the areas we noted important cross-fertilization could occur with space data awareness—*and they are already being blanketed with DoT regulation.*

There are so many variables, so many technologies. It is clear that the halting, hiccupping, unpredictable and cautionary regulatory model in place poses threats. In the works today are marvels like supersonic jets,[78] NASA's own megarocket[79] and proposed private alternatives,[80] and even the long-awaited space elevator, never mind that "key players have distanced themselves from the concept."[81] Regulatory approaches have already undermined and delayed steps needed to address issues of property rights in airspace/airsheds by simply ignoring them and imposing rules instead; ultimately such questions matter even more for the orbital and outer-space economy.

"The bottom line," as Rep. Babin put it with respect to the Section 108 report, "is that the Administration is asking for an expansion of regulatory authority for the Secretary of Transportation, in coordination with a number of other Federal agencies, to grant authorizations for missions in outer space"[82] FAA wants to take the lead—but it has not shown proper judgement or restraint in paving the way for liberalization of oversight in other sectors. The problem is compounded by the involvement of so many additional agencies apart from FAA; not merely Mother May I, but Mothers May I. A "failure to launch" of this particular regime would the best thing to happen for the commercial space sector.

Conclusion: Disruptive Technologies Versus Disruptive Washington

> *[H]is doom was that no man may ripen a field before harvest season.*
> —Poul Anderson, "The Man Who Came Early."

While we might once have engaged in 30,000 foot views of how to conduct regulatory policy, we now must take the 239,000 mile view. Decisions to be made in the future will require looking beyond the administrative state's inherent limitations, notably its foreclosing of the creation of new risk management "institutions of liberty" in frontier sectors.

With software, innovators may simply issue their product; but with biotech advances, every single incremental step needs major review procedures from the Food and Drug Administration. That binds technology to the speed of bureaucracy. The commercial space sector stands on the brink of similarly zealous regulation.

Without being utopian about it, government failure has always been a graver threat than transitory market failures. Government doesn't merely pick winners and losers; it influences business models and entire industry configurations, and entire economies. But technology and expertise outgrow the capabilities of central regulatory agencies, even granting that the regulatory or administrative state approach was ever fully appropriate.

The rationales for policy intervention in technology decrease rather than increase over time, as market failure reveals itself to have been failure to have markets at all. Still, elements of the technology sector broadly stand on the verge of being regulated like bygone-era utilities across

many fronts, with the commercial space sector now a worrisome special case. The industry is both fighting it, and asking for it, at the same time with its appeals for an illusory regulatory "certainty." Nimbleness matters, and companies need to be able to grow and test new ideas quickly, as well as shut operations down quickly without regulators looming. Private property rights themselves are likely to evolve in novel ways at the level of inter-orbital exploration. We recognize such rights at the individual level, and at the corporate; and may see more of what we might call the "inter-corporate" variety as "critical infrastructure" goes airborne. Such wealth-building relationships will be especially valuable in tomorrow's polycentric competition with "monopoly" governmental space programs like NASA. In fact, in the ideal, private space programs should be free from government competition,[83] let alone regulated by it.

Policymakers pondering the governance of commercial space activities should support disruptive technologies that are the real foundation of not just wealth but superior risk management and long-term infrastructure maintenance—rather than a disruptive Washington. We know that governments cannot be counted on to sustain their interests in long-term space programs in a fiscal/appropriations environment. The last moon landing was 46 years ago. That's no way to run a railroad; or space program.

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[10] "[Elon] Musk also said that NASA 'always has first priority,' and that if the agency wanted its own astronauts to be the first people to fly on a 'mission of this nature,' then 'of course NASA would take priority'." Calla Cofield, "SpaceX to Fly Passengers On Private Trip Around the Moon in 2018," *Space.com*, February 27, 2017. http://www.space.com/35844-elon-musk-spacex-announcement-today.html.

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March 8, 2017

Rep. Brian Babin
Chairman, Space Subcommittee
Committee on Science, Space & Technology
U.S. House of Representatives
2318 Rayburn House Office Building
Washington, DC 2003

Rep. Ami Bera
Ranking Member, Space Subcommittee
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Re: "Regulating Space: Innovation, Liberty & International Obligations"

Dear Chairman Babin and Ranking Member Bera:

TechFreedom writes to you regarding your hearing today to express our views about how Congress should approach the approval of "innovative space activities." Below, we sketch out a legal framework that we believe will allow American ingenuity to flourish beyond Earth orbit and ensure that America remains the lead spacefaring nation through the leadership of its private sector, while also satisfying our obligations under the Outer Space Treaty.

In the Commercial Space Launch Competitiveness Act of 2015 (CSLCA), Congress asked for various reports from potential regulators, and pursuant to Section 108, the Obama White House, through its Office of Science Technology and Policy (OSTP), wrote to Chairmen Thune and Smith on April 4, 2016 recommending an authorization and supervision approach to private outer space activities with specific proposed legislative language which has become known as a "Mission Authorization" regime.[3] This approach has been endorsed by COMSTAC and others.[4]

TechFreedom has reviewed the OSTP response and proposed legislative language and while we agree with the predicate that there is a "gap" in regulatory jurisdiction for activities

[3] Letter from John P. Holdren, Director & Assistant to the President for Science & Tech., to John Thune & Lamar Smith, Comm. on Science, Space & Tech. (Apr. 4, 2016), https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/csla_report_4-4-16_final.pdf, (last visited Feb. 20, 2017) [hereinafter OSTP Letter] (Stating "innovative, unprecedented space activities" are those activities that currently fall outside the regulatory domains of the three major licensing agencies: FAA (for launch and reentry); FCC (for frequency Use); NOAA (for Earth remote sensing)).

[4] *See* COMSTAC Meeting Notes of 10/21/15 (found at: https://www.faa.gov/about/office_org/headquarters_offices/ast/advisory_committee/meeting_news/archive/media/1021comstac_minutes.pdf).

beyond launch, reentry, frequency use and remote sensing, we believe the OSTP-proposed Mission Authorization approach will fail to give industry the regulatory certainty it needs, and instead will stifle innovation and capital formation for a space economy because it trusts unnamed bureaucrats with picking winners and losers — without transparency, accountability, or an appeals process. Instead, Congress should enact legislation that (i) makes clear those activities which are prohibited under international law (property claims of entire Celestial Bodies,[5] harmful contamination of planetary bodies,[6] placement of weapons of mass destruction in space,[7] *etc.*) and (ii) otherwise authorizes all other activities subject to a requirement that disputes between parties may be resolved through the courts and other dispute resolution mechanisms.

I. The U.S. Has Almost Unlimited Flexibility in Meeting its Obligations under OST Article VI

Article VI holds "States Parties to the Treaty ... responsib[le] for national activities in outer space," including those of their private actors, "and for assuring that national activities are carried out in conformity with the provisions set forth in the ... Treaty." Similarly, Article VII holds States "internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons" caused by their objects in space. These two obligations can be thought of as *per se* rules (*e.g.*, against militarizing space, territorial appropriation, harmful contamination) and rules of reason (*e.g.*, against harmful interference). The U.S. is responsible for making sure that its nationals do not violate any of the *per se* rules — and may not lawfully authorize any mission that would do so. But rules of reason are less simple in their application. The question is always going to be one of degree, of how to balance the costs and benefits of planned activity with the interests of other parties. In both of these cases, it is the U.S. that is ultimately liable to the international community for the activities of its citizens, and it is the U.S. that must decide how to design a regulatory regime to govern American companies that allocates that risk for the U.S. taxpayer.[8]

Conceptually, there is a wide range of options available for *ex ante* "authorizations" under Article VI. At one of the spectrum, the U.S. government could enact a law that (i) merely requires registration and contact information (meeting the "authorization" prong of Article

[5] 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 (hereinafter "OST"), Article II.

[6] OST Article IX.

[7] OST Article IV.

[8] If, for example, a U.S. entity were to attempt to bring back an asteroid into Low Earth Orbit for processing and somehow misjudged the reentry window, and the asteroid entered Earth atmosphere and landed on Madrid, it would be the United States government that would be responsible for the damage to the Spanish government (and its citizens), not the private company.

VI), (ii) specifies a short checklist of prohibited activities, and (iii) provides an enforcement mechanism on the part of the United States government to enjoin any activities it finds in the future to violate the OST (meeting the "continuing supervision" prong of Article VI).[9] At the other end of the spectrum would be a full licensing regime requiring FAR-like oversight of activities to make sure that a private entity could never put the United States in jeopardy of being liable for an OST breach under Article VI. While Congress seemed to message in CSCLA that this approach was untenable, we could easily see established bureaucracies pushing for this level of oversight either through direct regulation or informal practice.[10]

II. OSTP's "Mission Authorization" Structure Is Ripe for Mischief

Under OSTP's "Mission Authorization" approach, an inter-agency review process would be established for initial authorization. As proposed, the process lacks any transparency. There is no requirement in terms of processing times, no standards against which approval or disapproval are measured, no requirement for a full (or written) explanation of reasons for denial, and no appeals process. In short, the proposed review process looks uncannily like the State Department's International Traffic in Arms (ITAR) regime. That process has been abused by different governmental agencies countless times since it was imposed, resulting in the near death of the United States satellite building industry. In both cases, powerful governmental players on the inter-agency review team would apparently each have an independent veto on an authorization request. Most likely, the applicant would never find out who "blackballed" the mission, or why.[11]

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[9] Those who insist, simplistically, on complete "permissionless innovation" neglect to take into account the few fundamental prohibitions in the OST that cannot be avoided. Yet these prohibitions can be easily codified in U.S. law while allowing the vast majority (if not all) of the contemplated innovative activities to move forward without anything more than simple registration.

[10] Compare, for example, the level of outside oversight SpaceX launches under the NASA commercial cargo program go through compared with SpaceX launches of purely commercial cargo. This "failure is not an option" mentality when applied to non-human missions raises launch costs dramatically. As discussed below, any regulatory approach whereby a bureaucrat can deny a Mission Authorization because it might, somehow, implicate treaty concerns will surely destroy a nascent industry.

[11] An example of this abuse may shed light on how governments picking winners and losers is antagonistic to a free market economy. In 1999 a group of western investors leased the Russian Mir space station – with James Dunstan, one of the co-authors, serving as counsel to MirCorp. More than $30 million was invested and the group was in the process of seeking hundreds of millions more in investment to refurbish the aging space station and open it up to both tourists, and industrial users. MirCorp paid for the first private manned space launch (Soyuz TM-30, launched April 4, 2000). During that mission, MirCorp determined that Mir was in far better shape than Western media had implied, but was going to need additional boost capabilities to remain in orbit until MirCorp could assemble the first business users. The plan was to fly an innovative electromagnetic tether to Mir, and MirCorp sought ITAR approval to "export" the American tether for use on the Russian station. The application sat, and sat, and sat. No amount of inquiry could wrestle any information about the status of the application. The tether was of no significant military use: it would never be used on a spy satellite because it literally glows in the dark, such that humans on Earth can see its passage overhead. While that application sat in the inter-agency process, several agencies within the U.S. government was

If a regulatory regime is adopted for mission authorizations that mirrors, or even remotely resembles, the ITAR regime, then Congress will have failed, and commercial entities will flee the United States to jurisdictions that treat their citizens in a fair manner. To avoid repeating the mistakes of the ITAR regime, Congress must ensure that:

1. The **lead agency** in the inter-agency process must have the clout to push back against other agencies seeking to thwart private enterprise for their own reasons, which have little to do with U.S. national interests – and, indeed, may actively frustrate them (such as by strangling American industry). This is why we question whether having FAA/AST, as currently constituted, can be the lead agency.
2. **Clear processing guidelines** must be developed to keep agencies from blackballing projects on a whim. This will take a significant amount of expertise that is lacking even within FAA/AST. While that office has engineers capable of analyzing launch and reentry risks, it is ill-equipped to analyze, for example, whether Company B can mine an asteroid after Company A has already received authorization for such activities, or to determine how close Company B can land to Company A's lander on the Moon. In short, "non-interference" analyses will need to be conducted, and FAA/ATS does not have the expertise to do so. Agencies that *do* have that expertise might have an interest in conducting similar missions, calling into question the integrity of their analyses.[12]
3. The process must be **transparent**. Applicants must be able to find out where in the process they are, what agencies might have questions about the mission, and when a decision will be rendered.
4. Any denial must come with a **fully reasoned decision**. A simple "no" will turn off the private sector to this type of regulatory regime.
5. There must be an **appeal process**, whereby an applicant can challenge that decision in court. In short, the Administrative Procedures Act must apply to this process, rather than the "black box" that characterizes the ITAR process.

While it is theoretically possible to write legislation that would cover all of these "sins," we have no doubt but that bureaucrats, attempting to protect their own "turf," could find other ways of denying or slowing down a private sector company's attempt to conduct innovative space activities that might compete with a government program that is seeking billions of dollars of the federal budget.

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pressuring the Russians to ditch the Mir and concentrate on completing the first modules for the ISS. With Mir slowly deorbiting, with pressure from NASA and others, and with MirCorp unable to raise capital because of the uncertainty of Mir's future. Roscosmos, the Russian Space Agency, ultimately had no choice and announced that it would deorbit Mir on March 23, 2001. "Miraculously," MirCorp received its ITAR export authorization on March 24, 2001 – *the very next day*.

[12] Instances of government competing with the private sector in space abound. We can provide a laundry list of such instances if requested.

III. A "Mission Registration" Approach

Giving multiple agencies veto power is a recipe for delay and obstruction. Instead, we suggest allowing those planning to conduct a mission to register with a government entity, and provide full disclosure of the mission scenario. They would also have to demonstrate that the mission would not violate any of the OST prohibitions captured in the statute. An inter-agency review would be conducted under a strict shot-clock of 120 days; after that time, the mission would be deemed authorized, unless the lead agency issued an appealable order, consistent with the Administrative Procedure Act's "arbitrary and capricious" standard, clearly identifying the grounds on which the registration was denied.[13] In other words, self-certification of compliance with the statute would provide a presumption of compliance — a kind of safe harbor – but that presumption could, of course, be rebutted by the agency or any private party (domestic or, ideally, foreign as well) seeking to oppose the proposed mission as inconsistent with the Treaty.

A registrant would be under an obligation to keep the registering agency upraised of any changes to the mission, and the lead agency could in the future, if it later deemed that the mission might violate the OST prohibitions or other U.S. policy concerns, seek a court injunction to revoke the registration/authorization with the burden of proof or revocation resting with the government agency.[14]

IV. Dispute Resolution Under a Mission Registration Approach

The only "gap" this leaves in the regulatory jurisdiction of the United States is its obligation under Article IX of the OST not to authorize missions that might cause harmful interference to the activities of other "State Parties" or that might cause harmful contamination of space or celestial bodies (which, again, could be to future users). Some kind of system of tort law for the former and environmental law for the latter is inevitable.

In order to meet U.S. obligations under OST Article IX, we propose that the U.S. issue a Public Notice indicating that the application for registration has been filed and general information about mission type (*e.g.*, on-orbit satellite servicing, asteroid mining, etc.).[15] Another country (but not a foreign national) at that point could seek consultation with the United States if it

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[13] In order to curb "paper missions," (*see infra* Section IV), the statute should direct the lead agency to adopt general regulations specifying mission milestones for different types of missions similar to what the FCC has done with satellite licensing. A party missing a milestone would lose its registration and have to start the process over.

[14] We feel that any revocation would need to be done at the court level to assure an independent review of the revocation process. Allowing an agency to revoke the authorization subject to court appeal by the applicant would unfairly place the burden of proceeding and burden of proof with the private entity, and not on the government agency, where it belongs.

[15] A fuller registration of the payload would be made prior to launch consistent with the obligations of the Registration Convention.

believed that a mission might violate Article IX. The statute should be written such that other countries could not abuse the consultation process by objecting to each registration as a way of either slowing down U.S. interests, or gaining valuable proprietary information concerning the nature of the mission, or the technology involved.

The practical problem with the U.S. taking the "high road" of notifying the world community in advance of planned missions, however, is that it might prompt other nations to create "paper missions"[16] to stake out coveted locations in the solar system. A country, for example, could authorize a mission to land near Shackleton crater on the Moon and then claim a large non-interference zone around the landing site that would effectively preclude other operations nearby. Any "prior notice" regime, therefore, must come with strict milestones to demonstrate to the international community that such authorizations are legitimate. In that way, the United States can demand similar regimes from foreign governments in order to acknowledge any Article IX non-interference rights of their citizens.

A private party would be left with the ability to seek an injunction against another party it believed might cause harmful interference to its activities using traditional common law tort theories. As much as any particular private U.S. company might like to have the weight of the U.S. government behind it to enforce its rights to a particular mission, such a heavy-handed (and government-picking-winners) approach would be costly for the government to engage in, and simply not necessary given the well-established field of tort law. At most, Congress could consider requiring arbitration or other alternative dispute resolution platform in the statute for all cases arising under a Mission Registration regime. Ideally, the same common law developed between U.S. parties should be applicable in disputes between U.S. and foreign parties. For that to happen, the U.S. common law must be firmly grounded in Article IX's prohibition against harmful interference, while also taking care not to violate Article II's prohibition on territorial appropriation.

Respectfully,

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Berin Szóka, President, TechFreedom[19]

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[16] The International Telecommunication Union (ITU) and state regulatory bodies such as the FCC have long dealt with attempts to warehouse valuable orbital locations (especially within the geostationary orbit), through the filing of "paper satellite" applications – applications to provide service by entities clearly technically or financially unable to launch a satellite within the timeframes specified in those applications. This has led, on the U.S. side, to the implementation of very strict construction and launch milestones.

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Research Paper

The Future of Space Commercialization

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January 25, 2017

Executive Summary

This paper argues for the importance of commercial uses of outer space to the economy and national security of the United States. It lays out a short history of developments in commercial outer space, enumerates the challenges facing this emerging market, and offers suggestions for policies to address these challenges. It's not possible to provide comprehensive answers to all of the problems the United States may encounter in outer space, but the suggestions provided offer a starting point for creating a healthy, safe, and robust commercial space environment.

Commercial outer space can promote economic growth, innovation, and stronger national security. However, achieving these goals will require several changes in space policy:

- The Office of Commercial Space Transportation (FAA AST) should be elevated to a separate bureau under the Department of Transportation;
- Responsibility for situational awareness of non-national-security-related space assets should be placed in a non-profit, non-governmental, multi-stakeholder organization;
- When the government requires space capabilities, it should buy privately-provided services and encourage competition in launch and non-launch markets; and
- Government agencies with regulatory or oversight authority over the commercial space industry should default to approval for new missions. Agency procedures for overruling default approval should be transparent and should include a process of appeal.

The United States is on the cusp of having an independent commercial space market. With a few smart decisions and a policy of regulatory restraint, the government can simultaneously promote innovation, growth, and national security, while proving that enterprise in space does not require the backing of a large nation state. That would be a giant leap for mankind.

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Introduction

The launch of Sputnik in 1957 marked mankind's first foray outside the atmosphere of the planet it calls home. For the decades that followed, the main actors in space were nation-states. Large spacefaring countries built the vehicles that took people and cargo into orbit and to the moon, crafted international space law, and shaped the main investments in space technology.

In the early decades of space use, commercial access to space was primarily communications,[1] with limited remote imaging starting in the 1990s.[2] This started to change in the early 2000s with a combination of events. New commercial actors began to enter the space arena, looking to disrupt both space launch services and use space in new exotic ways. The U.S. government also moved its purposeful degradation of the Global Positioning System (GPS) signal to non-governmental devices.[3] This decision opened navigational and timing data across industries,[4] and eventually paved the way for personal navigation.[5]

Other countries have also ramped up their use of space. Of global government space expenditures in 2014, non-U.S. spending increased to 46 percent.[6] Internationally, the commercial sector grew to 76 percent of total space market share.[7] Outer space is no longer a playground reserved only for nation states. Despite the many benefits of this change, it also results in a host of new concerns. More actors in space means growing complexity and more potential for collisions or disagreements over orbital assignments. U.S. national security rests on access to its own communications, navigation, and reconnaissance space systems. Other countries look to expand their own security by using outer space, expanding potential conflict into orbit. International law about outer space is ambiguous at best, and domestic U.S. law has a range of organizational and regulatory complexities.

American space policy, and the private industry attached to it, rests on a delicate balance between foreign policy, domestic regulation, and technological development. The pressures on this balance have increased in recent years and the United States will have to revisit how it approaches outer space. The growing crowdedness, increasing number of spacefaring nations, and new uses of outer space are all burdens that the U.S. regulatory and security apparatus is not currently designed to handle. The growth of private launch services and commercial satellites is starting to strain the regulatory system that manages them. This strain, and the rise of new uses of outer space, have

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[1] Whalen, David J., "Communications Satellites: Making the Global Village Possible," NASA, Nov. 30, 2010, http://history.nasa.gov/satcomhistory.html.
[2] DigitalGlobe, "Commercial Remote Sensing: An Historical Chronology," April 9, 2010, http://lasp.colorado.edu/~bakerd/files/Uzzle_Remote_Sensing_04_06_2010.pdf.
[3] GPS.gov, "Selective Availability," Sept. 23, 2016, http://www.gps.gov/systems/gps/modernization/sa/.
[4] United States Department of Commerce, "U.S. Secretary of Commerce Wiliam M. Daley Applauds Decision to make Global Positioning System More Accurate for Civilian Users," May 1, 2000, http://www.gps.gov/systems/gps/modernization/sa/daley/.
[5] Fleishman, Glenn, "How the iPhone knows where you are," Macworld, April 28, 2011, http://www.macworld.com/article/1159528/smartphones/how-iphone-location-works.html.
[6] The Space Foundation, "The Space Report: 2015," 2015, https://www.spacefoundation.org/sites/default/files/downloads/The_Space_Report_2015_Overview_TOC_Exhibits.pdf.
[7] Ibid.

revitalized debates over what role the U.S. government should, or should not, play in overseeing commercial actors in outer space.

This paper will attempt to lay out the importance of commercial outer space, both to the United States' economy and its national security. It will also provide a short history of developments in commercial outer space, the challenges this emergent market faces, and some steps the United States could take moving forward. While it is beyond the scope of this paper to provide comprehensive answers to all of the problems the United States may encounter in outer space, the suggestions provided will hopefully be a starting point to creating a healthy, safe, and robust commercial space environment. Commercial outer space, if promoted properly, can induce economic growth, innovation, and stronger domestic security. This will require changes to how the government is organized to manage outer space (including where it places regulatory authority and how it handles space situational awareness), how it handles its own space business, and how regulators engage with space-based enterprises.

Part I: The Importance of Space

Outer space is relatively removed from daily life, yet it is more important than many expect. If one could drive upwards at 60 miles per hour, it would take less than one and a half hours to get to space.[8] Very few Americans, however, consider how space intersects with their lives on a constant basis. There are three areas in which it does so: (1) the economy; (2) innovation; and (3) national security.

The Space Economy

The size of the space economy is far larger than many may think. In 2015 alone, the global market amounted to $323 billion.[9] Commercial infrastructure and systems accounted for 76 percent of that total,[10] with satellite television the largest subsection at $95 billion.[11] The global space launch market's share of that total came in at $6 billion dollars.[12] It can be hard to disaggregate how space benefits particular national economies, but in 2009 (the last available report), the Federal Aviation Administration (FAA) estimated that commercial space transportation and enabled industries generated $208.3 billion in economic activity in the United States alone.[13] Space is not just about satellite television and global transportation; while not commercial, GPS satellites also underpin

[8] Glastonbury, Matt, "If you could drive a car upwards at 60mph, how long would it take to get to the moon?" *Science Focus,* Sept. 5, 2015, http://www.sciencefocus.com/qa/if-you-could-drive-car-upwards-60mph-how-long-would-it-take-get-moon.
[9] The Space Foundation, "The Space Report: 2016," 2016, http://www.spacefoundation.org/sites/default/files/downloads/The_Space_Report_2016_OVERVIEW.pdf.
[10] Ibid.
[11] FAA, "The Annual Compendium of Commercial Space Transportation: 2016," Jan., 2016, https://www.faa.gov/about/office_org/headquarters_offices/ast/media/2016_Compendium.pdf.
[12] Ibid.
[13] FAA, "The Economic Impact of Commercial Space Transportation on the U.S. economy in 2009," Sept., 2010, https://www.faa.gov/news/updates/media/Economic%20Impact%20Study%20September%202010_20101026_PS.pdf.

personal navigation, such as smartphone GPS use, and timing data used for Internet coordination.[14] Without that data, there could be problems for a range of Internet and cloud-based services.[15]

There is also room for growth. The FAA has noted that while the commercial launch sector has not grown dramatically in the last decade, there are indications that there is latent demand.[16] This demand may catalyze an increase in launches and growth of the wider space economy in the next decade. The Satellite Industry Association's 2015 report highlighted that their section of the space economy outgrew both the American and global economies.[17] The FAA anticipates that growth to continue, with expectations that small payload launch will be a particular industry driver.[18]

In the future, emerging space industries may contribute even more the American economy. Space tourism and resource recovery—e.g., mining on planets, moons , and asteroids—in particular may become large parts of that industry. Of course, their viability rests on a range of factors, including costs, future regulation, international problems, and assumptions about technological development. However, there is increasing optimism in these areas of economic production. But the space economy is not just about what happens in orbit, or how that alters life on the ground. The growth of this economy can also contribute to new innovations across all walks of life.

Technological Innovation

Innovation is generally hard to predict; some new technologies seem to come out of nowhere and others only take off when paired with a new application. It is difficult to predict the future, but it is reasonable to expect that a growing space economy would open opportunities for technological and organizational innovation.

In terms of technology, the difficult environment of outer space helps incentivize progress along the margins. Because each object launched into orbit costs a significant amount of money—at the moment between $27,000 and $43,000 per pound, though that will likely drop in the future[19]—each reduction in payload size saves money or means more can be launched. At the same time, the ability to fit more capability into a smaller satellite opens outer space to actors that previously were priced out of the market. This is one of the reasons why small, affordable satellites are increasingly pursued

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[14] Jewell, Don, "The Internet of Everything: it's All in the Timing," *GPS World*, June 20, 2015, http://gpsworld.com/the-internet-of-everything-its-all-in-the-timing/.

[15] Hollingham, Richard, "What would happen if all satellites stopped working?" *BBC Future*, June 10, 2013, http://www.bbc.com/future/story/20130609-the-day-without-satellites.

[16] The FAA notes that, "several new launch vehicles are being developed specifically to address what some believe is latent demand among small satellite operators." (The Federal Aviation Administration, "The Annual Compendium of Commercial Space Transportation: 2016," Jan. 2016, https://www.faa.gov/about/office_org/headquarters_offices/ast/media/2016_Compendium.pdf.)

[17] The Satellite Industry Association, "2016 State of the Satellite Industry Report," Sept. 2016, http://www.sia.org/wp-content/uploads/2016/09/SSIR16-2016-09-23-Update.compressed.pdf.

[18] The Federal Aviation Administration, "The Annual Compendium of Commercial Space Transportation: 2016," Jan., 2016, https://www.faa.gov/about/office_org/headquarters_offices/ast/media/2016_Compendium.pdf.

[19] Kramer; Mosher, "Here's how much money it actually costs to launch stuff into space," *Business Insider*, Jul. 20, 2016, http://www.businessinsider.com/spacex-rocket-cargo-price-by-weight-2016-6/#does-this-sound-ridiculously-expensive-10.

by companies or organizations that cannot afford to launch larger traditional satellites.[20] These small satellites also provide non-traditional launchers, such as engineering students or prototypers, the opportunity to learn about satellite production and test new technologies before working on a full-sized satellite. That expansion of developers, experimenters, and testers cannot but help increase innovation opportunities.

Technological developments from outer space have been applied to terrestrial life since the earliest days of space exploration. The National Aeronautics and Space Administration (NASA) maintains a website that lists technologies that have spun off from such research projects.[21] Lightweight nanotubes, useful in protecting astronauts during space exploration, are now being tested for applications in emergency response gear and electrical insulation. The need for certainty about the resiliency of materials used in space led to the development of an analytics tool useful across a range of industries. Temper foam, the material used in memory-foam pillows, was developed for NASA for seat covers. As more companies pursue their own space goals, more innovations will likely come from the commercial sector.

Outer space is not just a catalyst for technological development. Satellite constellations and their unique line-of-sight vantage point can provide new perspectives to old industries. Deploying satellites into low-Earth orbit, as Facebook wants to do,[22] can connect large, previously-unreached swathes of humanity to the Internet. Remote sensing technology could change how whole industries operate, such as crop monitoring, herd management, crisis response, and land evaluation,[23] among others. While satellites cannot provide all essential information for some of these industries, they can fill in some useful gaps and work as part of a wider system of tools. Space infrastructure, in helping to change how people connect and perceive Earth, could help spark innovations on the ground as well. These innovations, changes to global networks, and new opportunities could lead to wider economic growth.

National Security

Perhaps the most important legacy application of outer space for Americans is national security. The United States relies heavily on satellites for capabilities that make its global power projections and deterrence structures work. Satellites provide valuable real-time intelligence information, connect platforms and bases around the world, and provide the basis for highly accurate navigational systems on land, at sea, and in the air.

It is not just that this space infrastructure is useful for American warfighters, but that it is essential. Elbridge Colby, a senior fellow at the Center for a New American Security (CNAS), wrote in his examination of recent changes to the space environment that space capabilities are "the stuff of

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[20] Batencourt, Mark, "Rise of the CubeSats," *Air & Space Smithsonian*, Jan. 20, 2016, http://www.airspacemag.com/space/rise-cubesats-180957827/?no-ist.

[21] NASA, "NASA Spinoff 2016," *INSIDE 2016,* https://spinoff.nasa.gov/Spinoff2016/toc_2016.html.

[22] Dzonzi, Prinsloo, "Facebook is Launching Rural Internet Access Via Satellite for Africa," *Bloomberg*, Aug. 31, 2016, http://www.bloomberg.com/news/articles/2016-08-31/facebook-to-start-africa-satellite-this-week-to-find-rural-users.

[23] U.S. Committee on Science and Technology, "Remote Sensing Data: Applications and Benefits," April 7, 2008, https://www.gpo.gov/fdsys/pkg/CHRG-110hhrg41573/html/CHRG-110hhrg41573.htm.

which American global military primacy is made."[24] Military capabilities that the United States has come to rely on, from remotely piloted drones to precision weaponry, all rely on satellites.[25] To manage this, The United States Space Command has 38,000 airmen based around the world working to secure access to national security space assets.[26]

It is not just the military that relies on satellites—the intelligence community does too. While the unclassified military space budget is around $10 billion on outer space a year,[27] total national security space spending may be over $25 billion annually.[28] This reliance on outer space is not going to end any time soon. At an event at the Center for Strategic and International Studies (CSIS) on October 24, 2016, Deputy Assistant Secretary of Defense for Space Policy Doug Loverro, spoke to the importance of leveraging space capabilities.[29] Mr. Loverro highlighted that space is fundamental to everything the United States does in conventional war, as well as nuclear deterrence, and disabused the notion that the country should pursue ways of fighting and projecting power without relying on outer space. Such an argument, he contends, is "not an attractive notion." Going to war without space capabilities would put American soldiers at risk.

Even so, managing the space environment is becoming more complex for the defense community. There is a growing perception that heavy reliance on satellites creates a soft spot in American defenses.[30] America's rivals have highlighted U.S. space capabilities as a possible vulnerability to exploit.[31] For some capabilities—particularly situational awareness, nuclear command and control, and coordination among America's widespread military and intelligence assets—satellites have become an almost "single point of failure."[32] This means that any one accident or disruption could degrade or shut down a key tool. Concerns over this reliance have led to warnings of a "space Pearl Harbor"[33] as defense analysts see American outer space assets as potentially ripe targets for exploitation by international rivals.[34]

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[24] Colby, Elbridge, "From Sanctuary to Battlefield: A Framework for a U.S. Defense and Deterrence Strategy in Space," *Center for a New American Security*, Jan. 2016, https://s3.amazonaws.com/files.cnas.org/documents/CNAS-Space-Report_16107.pdf.

[25] Martin, David, "The Battle Above," *60 Minutes, CBS*, April 26, 2015, http://www.cbsnews.com/news/rare-look-at-space-command-satellite-defense-60-minutes/.

[26] Ibid.

[27] The Space Foundation, "U.S. Defense Space-Based and -Related Systems: Fiscal Year 2015 Budget Comparison," 2015. http://www.spacefoundation.org/sites/default/files/downloads/Update%206%20FY%202015%20DoD%20Space%20Budget%20Comparison.pdf.

[28] The amount of actual spending is not publically available, given classified spending - Martin, David, "The Battle Above," *60 Minutes, CBS*, April 26, 2015, http://www.cbsnews.com/news/rare-look-at-space-command-satellite-defense-60-minutes/.

[29] CSIS, "The U.S. Military and Commercial Space Industry," Oct. 24, 2016, https://www.csis.org/events/us-military-and-commercial-space-industry.

[30] Billings, Lee, "War in Space May be Closer Than Ever," *Scientific American*, Aug. 20, 2015, https://www.scientificamerican.com/article/war-in-space-may-be-closer-than-ever/.

[31] Colby, Elbridge, "From Sanctuary to Battlefield ... ," *Center for a New American Security*, Jan. 2016, https://s3.amazonaws.com/files.cnas.org/documents/CNAS-Space-Report_16107.pdf.

[32] Clark, Colin, "Space Command Readies for War with 'Space Enterprise Vision," *BreakingDefense*, June 20, 2016, http://breakingdefense.com/2016/06/space-command-readies-for-war-with-space-enterprise-vision/.

[33] Broder, Jonathan, "Why the Next Pearl Harbor could happen in Space," *Newsweek*, May 4, 2016, http://www.newsweek.com/2016/05/13/china-us-space-wars-455284.html.

[34] Clark, Colin, "Space Command Readies for War with 'Space Enterprise Vision."

The United States is moving to mitigate some of these concerns by making more resilient and adding redundancy to the system. That way, if one satellite is damaged or degraded, the system as a whole still functions.

The success or failure of these efforts may ultimately depend on commercial outer space. Building up U.S. space capabilities solely through government initiative could have both fiscal and operational problems—such a strategy would likely be expensive and spread unforeseen vulnerabilities across the entire American satellite fleet.

Working with commercial companies for capabilities can reduce costs while providing strength through variation.[35] Commercial satellites, for example, currently provide the military with 80 percent of its satellite communications needs.[36] Commercial providers also provide the vital launch services that get the satellites into orbit. Today, these providers are the United Launch Alliance (ULA)[37] and Space Exploration Technologies (SpaceX).[38] Without these companies, the United States government would have to rebuild national launch capabilities. In the future, other commercial launch companies, such as Orbital ATK[39] and Blue Origin,[40] could also provide launch services for the military and intelligence community. In short, a more robust commercial space market is key to ensuring the resilience of American national security by assuring access to space.

Part II: A Brief History of Commercial Use of Outer Space

The roots of the human enterprise in space trace back to competition between the Soviet Union and the United States. The concern that the geopolitical rivalry and nuclear arms race between the two superpowers would extend into outer space culminated in the 1967 Outer Space Treaty (OST).[41] It attempted to smooth over concerns between the United States and the Soviet Union about the other placing nuclear weapons in space. Wider issues were also addressed. Each country would respect the other's space vehicles and astronauts, neither would claim sovereignty over celestial bodies, and neither would station weapons of mass destruction in space. Most importantly for the commercial use of outer space, each would assume responsibility for the actions of their private individuals and companies in outer space. Since 1967, 91 countries have signed the OST—including all of the current major spacefaring nations.[42]

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[35] CSIS, "The U.S. Military and Commercial Space Industry."
[36] Lober, Rick, "Why the Military Needs Commercial Satellite Technology," *Defense One*, Sept. 25, 2013, http://www.defenseone.com/technology/2013/09/why-military-needs-commercial-satellite-technology/70836/.
[37] While a commercial company, ULA was originally created as the sole-source launch provider for the military. United Launch Alliance, http://www.ulalaunch.com/.
[38] Space Exploration Technologies, http://www.spacex.com/.
[39] Orbital ATK, https://www.orbitalatk.com/.
[40] Blue Origin, https://www.blueorigin.com/.
[41] Official title: The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies.
[42] U.S. Department of State, "The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies," *Bureau of Arms Control, Verification, and Compliance*, Jan. 27, 1967, http://www.state.gov/t/isn/5181.htm#signatory.

American interest in the commercial use of outer space can be traced back to the National Aeronautics and Space Act of 1958.[43] In it Congress declared that it was to the benefit of the United States for the concurrently established National Aeronautics and Space Administration (NASA) to "seek and encourage, to the maximum extent possible, the fullest commercial use of space."[44] Subsequent presidential administrations have maintained this policy.

Under President Johnson, the expectation that non-state actors would operate in space was reflected in the OST.[45] President Carter, in his National Space Policy of 1978, reasserted that the United States would encourage domestic use of outer space both for "economic benefit" and the "technological position of the United States."[46] The Reagan Administration dramatically shifted domestic consideration of commercial space policy, at least as it applied to National Space Policy.

At first, President Reagan's National Space Policy of 1982 carried over language similar to that used by President Carter.[47] By 1988, however, President Reagan's second National Space Policy had elevated commercial space to the same significance as civil and national security space.[48] Commercial space was addressed in more detail, with the word "commercial"appearing 68 times in the document.[49] The policy directed the government to purchase commercial capabilities, avoid crowding out private investment where possible, and take as light an approach to commercial space regulation as possible.

President H.W. Bush not only maintained the Reagan Administration's policies,[50] but specified in greater detail how the government should promote commercial space.[51] Additionally, the first Bush administration's space policy included commercial launch needs into overall launch strategy.[52] The Clinton Administration expanded space policy further, advocating for government use of commercial space products and services "to the fullest extent possible."[53] Additionally, the Clinton Administration highlighted "free and fair trade" in commercial space launch as an American goal.[54] Under President George W. Bush, the U.S. government's attention shifted away from space after the terrorist attacks of September 11, 2001. The 2006 National Space Policy took a similar view to commercial outer space

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[43] Air University, "National Space Policy," *United States Air Force*, http://www.au.af.mil/au/awc/awcgate/au-18/au180046.htm.
[44] NASA, *National Aeronautics and Space Act of 1958, as amended*, Aug. 25, 2008, p. 4., http://history.nasa.gov/spaceact-legishistory.pdf.
[45] NASA, *The Outer Space Treaty of 1967*, Oct. 26, 2006, http://history.nasa.gov/1967treaty.html.
[46] The White House, *Presidential Directive/NSC-37*, Jimmy Carter Presidential Library, May 11, 1978, https://www.jimmycarterlibrary.gov/documents/pddirectives/pd37.pdf.
[47] The White House, *National Security Decision Directive 42*, NASA Historical Reference Collection, July 4, 1982, https://www.hq.nasa.gov/office/pao/History/nsdd-42.html.
[48] Air University, "National Space Policy," *United States Air Force*, http://www.au.af.mil/au/awc/awcgate/au-18/au180046.htm.
[49] The White House, *Presidential Directive on National Space Policy*, NASA Historical Reference Collection, Feb. 11, 1988, https://www.hq.nasa.gov/office/pao/History/policy88.html.
[50] The White House, *National Space Policy Directives and Executive Charter*, Air University, Nov. 2, 1989, http://www.au.af.mil/au/awc/awcgate/nspd1.htm.
[51] The White House, *U.S. Commercial Space Policy Guidelines - NSPD-3*, Air University, Feb. 11, 1991, http://www.au.af.mil/au/awc/awcgate/nspd3.htm.
[52] The White House, *National Space Launch Strategy - NSPD-4*, Air University, July 10, 1991, http://www.au.af.mil/au/awc/awcgate/nspd4.htm.
[53] The White House National Science and Technology Council, "Fact Sheet: National Space Policy," Sept. 19, 1996, http://history.nasa.gov/appf2.pdf.
[54] Ibid.

as the previous administrations.[55] However, the post-1999 placement of all space technologies under the International Traffic in Arms Regulation (ITAR) munition list started taking a toll on the industry.[56]

Under President Obama, national use and reliance on commercial space products and services had also been a major focus of the National Space Policy.[57] In particular, the Obama Administration pursued increased use of commercial launch services, including low-earth orbit satellite launches and resupply missions to the International Space Station (ISS).[58] This long focus on promoting commercial outer space throughout successive administrations has been a major catalyst for the dynamic commercial space industry that exists in the United States. The Obama Administration also reviewed the export control regime for space, and with Congressional support, shifted some satellites and related technologies from the stricter ITAR munitions list to the looser Export Administration Regulations (EAR) list in 2014.[59]

The commercial sector was an early player in the use of space, at least in terms of communications satellites. In 1960, AT&T filed an application with the Federal Communications Commission (FCC) for an experimental satellite—before the United States even had policies in place to manage such a request.[60] The private sector was, even then, pushing the boundaries of innovation in space. Domestically, the U.S. government retained a monopoly on access to space for years. Between the 1960s and the 1980s, anything launched into orbit—including commercial satellites—had to travel on the government's launch vehicles.

In 1984, the United States passed the Commercial Space Launch Act (CSLA).[61] The law gave the Department of Transportation (DOT) the authority to regulate commercial space launch activities—although it did not grant authority to regulate movements in orbit or beyond.[62] The CSLA opened up the ability for American companies to launch satellites on launch vehicles not completely controlled by the government.[63] It took a while for a private company to send a payload into space, however. In fact, the first commercial launcher in the Western world was created when a private company, Arianespace, took over operations of the European Space Agency's Ariane launch vehicle.[64]

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[55] The Office of Science and Technology Policy, *U.S. National Space Policy*, NASA Historical Reference Collection, Sept. 14, 1996, http://history.nasa.gov/ostp_space_policy06.pdf.
[56] Zelnio, Ryan, "The effects of export control on the space industry," *The Space Review*, Jan. 16, 2006, http://www.thespacereview.com/article/533/1.
[57] The White House, *National Space Policy of the United States of America*, NASA Historical Reference Collection, June 28, 2010, http://history.nasa.gov/national_space_policy_6-28-10.pdf.
[58] The White House, *National Space Transportation Policy*, NASA Historical Reference Collection, Nov. 21, 2013, http://history.nasa.gov/nstp11-21-13.pdf.
[59] Bureau of Industry and Security, "Export Control Reform: Spacecraft/Satellites," *Department of Commerce*, 2014, https://www.bis.doc.gov/index.php/forms-documents/pdfs/1008-satellites-final-rules/file.
[60] Whalen, David, "Communications Satellites: Making the Global Village Possible," NASA, Nov. 30, 2010, http://history.nasa.gov/satcomhistory.html.
[61] Authorities now under *U.S.C. 51, Chapter 509*, http://uscode.house.gov/view.xhtml?path=/prelim@title51/subtitle5/chapter509&edition=prelim.
[62] SpacePolicyOnline, "Space Law," http://www.spacepolicyonline.com/space-law.
[63] The first commercial space launch entity was actually established in Europe in 1980 - Arianespace, "Milestones," http://www.arianespace.com/company-milestones/.
[64] FAA, "Origins of the Commercial Space Industry," https://www.faa.gov/about/history/milestones/media/Commercial_Space_Industry.pdf.

In the United States, interest in commercial launch companies picked up when it became clear that the Space Shuttle would not be able to maintain a schedule rigorous enough to cover commercial launch demands.[65] After the *Challenger* explosion, President Reagan issued an order banning commercial payloads on the Shuttles.[66] Private consumers turned to expendable launch vehicles for reliable services. The first American-licensed commercial launch occurred in 1989 when Space Services, Inc. sent a payload into orbit on a Starfire rocket.[67] Commercial launch development had begun, but remained focused on communications and imaging for the next decade.

This started to change at the turn of the century, however. Prior to May 2000, non-governmental access to the GPS was purposefully degraded.[68] That degradation had limited the beneficial uses of GPS for the commercial sector, restricting accuracy to 100 meter radii. With those restrictions lifted, commercial use of GPS expanded across a range of industries.[69] This decision would eventually lead to the ability of individuals to rely on GPS for personal navigation.[70]

The new millennium also saw a growing number of commercial actors interested in more exotic uses of outer space. In 2000, Amazon founder Jeff Bezos created a company with the aim of getting tourists into suborbital space.[71] The company—Blue Origin—was the first to land a reusable rocket booster in 2015. It has since repeated the feat several times. In 2002, PayPal tycoon Elon Musk founded SpaceX, which became the first private company to return a spacecraft from low-earth orbit to Earth.[72] SpaceX has since won contracts with NASA to run supply trips to the ISS and has landed a reusable booster system several times. Richard Branson founded Virgin Galactic to pursue space tourism in 2004, and cofounded The Spaceship Company in 2005 to produce the spacecraft for that tourism.[73] His companies are working with the engineer that won the Ansari X Prize (announced in 1996)[74] to turn that reusable suborbital vehicle into a viable space tourism platform.[75] Bigelow Aerospace, founded in 1999, has focused on building habitats that can be more easily deployed to outer space or other celestial bodies. It launched prototypes in 2006 and 2007,[76] and currently has a test capsule attached to the ISS.[77] Other companies wanting to extract celestial resources, like Planetary Resources, are eyeing potential paydays from asteroids.[78] Most recently, Moon Express—a

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[65] Ibid.
[66] NASA, *Commercial Orbital Transportation Services: A New Era In Spaceflight*, NASA, Feb., 2014, https://www.nasa.gov/sites/default/files/files/SP-2014-617.pdf.
[67] FAA, "Origins of the Commercial Space Industry."
[68] GPS.gov, "Selective Availability," Sept. 23, 2016, http://www.gps.gov/systems/gps/modernization/sa/.
[69] United States Department of Commerce, "U.S. Secretary of Commerce William M. Daley ...," May 1, 2000, http://www.gps.gov/systems/gps/modernization/sa/daley/.
[70] Control over the space and ground segments remained under government control, though there were proposals to privatize them as well.
[71] Malik, Tariq, "Jeff Bezos' Blue Origin Launches and Lands Private Rocket for Third Time," *Space.com*, April 2, 2016, http://www.space.com/32453-blue-origin-launches-and-lands-rocket-third-time.html.
[72] Space Exploration Technologies, http://www.spacex.com/about.
[73] The Spaceship Company, http://thespaceshipcompany.com/.
[74] The Ansari X Prize awarded $10 million to the first group to privately launch a manned system to 100km above Earth's surface twice within two weeks. http://ansari.xprize.org/.
[75] Howell, Elizabeth, "Virgin Galactic: Richard Branson's Space Tourism Company," *Space.com*, Feb. 17, 2016, http://www.space.com/18993-virgin-galactic.html.
[76] Bigelow Aerospace: https://bigelowaerospace.com/.
[77] Wall, Mike, "Astronauts Enter Inflatable Space Station Module for 1st Time," *Space.com*, June 6, 2016, http://www.space.com/33087-astronauts-enter-inflatable-space-station-habitat.html.
[78] Planetary Resources: http://www.planetaryresources.com/.

company with the goal of mining lunar resources—received a positive payload review from the FAA to send the first private rover to the Moon.[79]

There are also more traditional aerospace companies (that have other portfolios) that have won contracts to ferry cargo to the ISS, including Orbital ATK and the Sierra Nevada Corporation. The growth of the commercial space market has been impressive. The Space Foundation's 2016 report found that the overall space economy had reached $323 billion in 2015.[80] The commercial space industry, and the infrastructure supporting it, accounted for 76 percent of the space economy.

Today, the commercial component of the space economy encompasses everything from satellite communications, broadcasting, and remote imaging to the terrestrial infrastructure and workforce that supports those satellites.[81] From OneWeb to SpaceX, more and more companies are looking to deploy their own satellite systems to provide direct Internet connections around the world.[82] With innovations and technological progress in remote imaging, companies like Planet Labs are marketing satellite Earth observations to a diverse array of markets, from agriculture to energy production.[83] Human rights groups are using remote imaging to document war crimes,[84] gaining data in hours for much lower costs and risk than dispatching on-the-ground teams. The economic benefits from space also come when companies and people can hook into government satellite constellations. National navigation systems, such as the GPS constellation, provide highly accurate timing data for billions of Internet users and millions of systems[85]—data that if unavailable would cause potential problems for the Internet and cloud-based computing services.[86]

Part III: Challenges Ahead

The growth of the space market has sparked growing interest in regulation. With private companies wanting to launch thousands of new satellites, the U.S. government is looking at how best to undertake space traffic management.[87] Certain parts of the potential space economy, such as mining resources from asteroids, raise concerns about possible clashes between American ambition and

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[79] Wall, Mike, "Moon Express Approved for Private Lunar Landing in 2017, a Space First." *Space.com*, Aug. 3, 2016, http://www.space.com/33632-moon-express-private-lunar-landing-approval.html.

[80] The Space Foundation, "The Space Report: 2016," 2016, http://www.spacefoundation.org/sites/default/files/downloads/The_Space_Report_2016_OVERVIEW.pdf.

[81] Ibid.

[82] Patterson, Thom, "Google, Facebook, SpaceX, OneWeb plan to beam Internet everywhere," *CNN*, Nov. 9, 2015, http://www.cnn.com/2015/10/30/tech/pioneers-google-facebook-spacex-oneweb-satellite-drone-balloon-internet/.

[83] Planet Labs: https://www.planet.com/markets/.

[84] Friedman, Uri, "What War Crimes Look Like from Space," *The Atlantic*, Feb. 11, 2015, http://www.theatlantic.com/international/archive/2015/02/satellites-human-rights-space-nigeria/385063/.

[85] Jewell, Don, "The Internet of Everything: it's All in the Timing," *GPS World*, June 20, 2015, http://gpsworld.com/the-internet-of-everything-its-all-in-the-timing/.

[86] GPS data is used for the timestamps on packets of data transferred between computers. Inaccuracies in these timestamps mean slower Internet and inability to transfer data. Accuracy of location would be degraded with the loss of GPS, which could cause major transportation issues. Location-based services for mobile users would also be disrupted. *See generally* Hollingham, Richard, "What would happen if all satellites stopped working," *BBC*, June 20, 2013, http://www.bbc.com/future/story/20130609-the-day-without-satellites.

[87] Gruss, Mike, "Washington Weighs an FAA Role in Managing Space Traffic," *Space News*, Dec. 3, 2015, http://spacenews.com/might-the-faa-inherit-the-space-traffic-management-role/.

international law.[88] The Moon-bound Moon Express rover in particular has given rise to questions about which government agency (if any) should have regulatory authority over such missions and what the best approach to such authorities would be. Private industry also lacks certainty on a range of possible missions, with no clear indication as to what will be permitted.

The answers to these questions are complex, tying together a range of challenges facing the use and exploration of outer space. Some of these challenges are technical, while some are environmental. Some of these challenges are created by current regulatory approaches, and some may be created in the future by new regulations. Commercial outer space also ties into wider national security and international relations concerns. Any policies that deal with outer space have to take into account these varying, and sometimes contradictory, pressures on the commercial space market.

The recent success of the commercial space market comes not with a lack of challenges, but in spite of them. These challenges can be divided under the following general sections: (1) a technically difficult space environment, (2) regulatory burdens, (3) national security ramifications, and (4) international disagreements.

Technical

Accessing outer space is technically challenging and can be dangerous. The Space Shuttle program, designed to provide reusable and routine access to space,[89] suffered the loss of two shuttles out of five—a 40 percent vehicular failure rate.[90] Granted, those accidents occurred over the shuttle's entire 30-year lifespan, but the loss of 14 people onboard those shuttles still outnumbers all casualties from all other global space launch systems combined.[91]

The commercial sector has seen its fair share of accidents as well. In 2014, the breakup of Virgin Galactic's SpaceShipTwo killed the copilot and injured the pilot.[92] In June 2015, one of SpaceX's Falcon Rockets exploded during launch, destroying the cargo meant for the ISS.[93] SpaceX had another rocket explode on September 1, 2016, during a routine test-fire,[94] destroying a satellite bought by Facebook to provide Internet to parts of Africa.

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[88] Davalos, Juan, "International Standards in Regualting Space Travel: Clarifying Ambiguities in the Commercial Era of Outer Space," *Emory International Law Review*, 2016, http://law.emory.edu/eilr/content/volume-30/issue-4/comments/standards-regulating-space-travel-ambiguities-outer-space.html.

[89] Siceloff, Steven, "Shuttle Fleet Left Mark in Space, Hearts," *NASA*, Feb. 1, 2015, https://www.nasa.gov/mission_pages/shuttle/flyout/shuttleachievements.html.

[90] Pinchefsky, Carol, "5 horrifying facts you didn't know about the space shuttle," *Forbes*, April 18, 2012, http://www.forbes.com/sites/carolpinchefsky/2012/04/18/5-horrifying-facts-you-didnt-know-about-the-space-shuttle/#28a3acc067b9.

[91] A launch pad test killed three astronauts in an Apollo I mission, and Russian space missions have had four total deaths. There have, as yet, been no reported Chinese taikonaut deaths.

[92] National Transportation Safety Board, "Commercial Space Launch Accident - SpaceShipTwo," July 28, 2015, http://www.ntsb.gov/news/events/Pages/2015_spaceship2_BMG.aspx.

[93] Wall, Mike, "SpaceX Rocket Explosion Likely Caused by Faulty Strut, Elon Musk Says," *Space.com*, July 20, 2015, http://www.space.com/29994-spacex-rocket-explosion-cause-faulty-strut.html.

[94] Calandrelli, Emily, "Here's what we know about the SpaceX explosion," *Techcrunch*, Sept. 1, 2016, https://techcrunch.com/2016/09/01/here-what-we-know-about-the-spacex-explosion/.

Launching rockets is clearly difficult. Reusing boosters for launch systems, as some companies have begun to do, is even more technically challenging. Both Blue Origin[95] and SpaceX[96] have demonstrated the capability to land their boosters after launch and intend to use these boosters to cut down on the overall costs of launches. Neither company has used a landed booster to launch governmental or commercial cargo, though they are getting closer to doing so. Blue Origin has used its rocket multiple times in a variety of tests,[97] and SpaceX has inked a contract to launch a commercial satellite with one of its previously used boosters.[98] Reusing a rocket comes with risks; and until reusable systems can be repeatedly demonstrated to be safe, customers and regulators may remain wary.[99] Newer, more complex systems may also see higher insurance rates; space insurers are already warning that they expect rates to increase.[100] Commercial concerns aside, launching government payloads or astronauts may require even more stringent checks if concerns over reusable rockets remain.

Of course, once in space, things do not get easier. The space environment is intensely challenging, with everything from dust to radiation being a potential issue. For companies wanting to move beyond orbit—for reasons that range from asteroid mining to exploration missions—problems will run the spectrum from the known to the unpredictable. As commercial companies expand outwards, they'll have to deal with expected problems like radiation and fuel generation, as well as whatever unanticipated issues may arise. For the companies focused on in-orbit capabilities, the most pressing technical problem will be debris.

Space Debris

Space debris is an increasingly problematic technical issue. As the number of state and private actors launching satellites increases, the amount of debris in orbit—defunct satellites, booster parts, bits of metal and scrap—also increases. In 2013, NASA reported that there were over 500,000 trackable pieces of space debris in orbit.[101] The problem has become worse since then and will continue to pose a real threat to spacecraft.

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[95] Malik, Tariq, "Blue Origin Aces 4th Reusable Rocket Launch (and Landing) in Live Webcast," *Space.com*, June 19, 2016, http://www.space.com/33214-blue-origin-lands-reusable-rocket-4th-time-webcast.html.

[96] Wall, Mike, "No. 5! SpaceX Lands Another Rocket During Space Station Cargo Launch," *Space.com* July 18, 2016, http://www.space.com/33443-spacex-dragon-launch-rocket-landing.html.

[97] Smith, Rich, "When Will SpaceX Catch Up to Blue Origin in Rocket Reusability?" *The Motley Fool*, June 11, 2016, http://www.fool.com/investing/2016/06/11/when-will-spacex-catch-up-to-blue-origin-in-rocket.aspx.

[98] De Selding, Peter, "SpaceX to launch SES-10 on previously flown Falcon 9 this year," *SpaceNews*, Aug. 30, 2016, http://spacenews.com/spacex-to-launch-ses-10-satellite-on-reused-falcon-9-by-years-end/.

[99] These concerns largely center on the condition of the rocket after each successive launch, given the high velocities and heat involved. *See generally* Masunaga, Samantha, "Rocket science? Check. But can SpaceX get through insurance hurdles?" *Los Angeles Times*, June 3, 2016, http://www.latimes.com/business/la-fi-spacex-insurers-20160603-snap-story.html.

[100] De Selding, Peter, "Space Insurers warn that current low rates are not sustainable," *SpaceNews*, Oct. 10, 2016, http://spacenews.com/space-insurers-warn-that-current-low-rates-are-not-sustainable/.

[101] Garcia, Mark, "Space Debris and Human Spacecraft," *NASA*, Sept. 26, 2013, http://www.nasa.gov/mission_pages/station/news/orbital_debris.html.

For example, the ISS has had to alter its orbit to avoid a potential collision.[102] In 2014, satellites were maneuvered over 120 times to reduce the risk of potential collisions with debris.[103] In 2009, there was a collision between two satellites—the first involving an operational satellite.[104] Space debris can be created quickly. Two events, the satellite collision in 2009 and the destruction of a satellite by China in 2007, created an estimated one-third of the actively-tracked debris in low-earth Orbit.[105]

To date, debris has not yet caused serious damage to space assets. However, this may not be the case in the future. The number of launches and satellites in orbit will grow significantly in the near future. There are currently around 1,500 operational satellites orbiting Earth,[106] and commercial space companies are looking to greatly expand this number. SpaceX submitted plans to the FCC for a constellation of 4,000 satellites to be deployed in the next five years.[107] Boeing applied to the FCC to deploy 1,396 satellites in the next six years.[108] These plans may not come to fruition, but it is clear that there is strong interest in expanding the number of satellites in orbit. This will increase the amount of debris, and the risk of collisions.

The debris issue may result in either regulatory steps taken to coordinate launches and reduce risks of accidental collisions or technological innovations to assist in "cleaning" the orbital environment. Either approach, however, will likely require delicate international negotiations and will require greater global cooperation than currently exists.

Current Regulations

Current American regulations focus on systems leaving or entering Earth's atmosphere and the capabilities of satellites in orbit. The current regulatory structure spans several government agencies, leading to a somewhat disjointed structure. While workable during an era of single-use outer space operations (placing satellites or space stations in orbit), it has become increasingly inadequate as more private actors enter the space economy and seek new opportunities.

To get a satellite in orbit, companies must go through the payload review process for launches and reentries.[109] This process is undertaken by the FAA's Office of Commercial Space Transportation (FAA AST), which has to sign off on a variety of checks before a launch can take place, including: flight termination system design testing, operating techniques, launch and reentry sites, and whether the

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[102] Ibid.

[103] Weedon, Brian, "Why Outer Space Matters: Brian Weedon on Natural and Human-Generated Threats on Satellites," Oct. 24, 2016, http://intercrossblog.icrc.org/blog/why-outer-space-matters-brian-weeden-on-natural-and-human-generated-threats-on-satellites.

[104] David, Leonard, "Effects of Worst Satellite Breakups in History Still Felt Today," *Space.com*, Jan. 28, 2013, http://www.space.com/19450-space-junk-worst-events-anniversaries.html.

[105] Ibid.

[106] Union of Concerned Scientists, "UCS Satellite Database," Aug. 11, 2016, http://www.ucsusa.org/nuclear-weapons/space-weapons/satellite-database#.V7HTwJMrKfc.

[107] De Selding, Peter, "SpaceX To Build 4,000 Broadband Satellites in Seattle," *SpaceNews*, Jan. 19, 2015, http://spacenews.com/spacex-opening-seattle-plant-to-build-4000-broadband-satellites/.

[108] Masunaga, Samantha, "Boeing applies for license to launch proposed satellite constellation," *Los Angeles Times*, June 23, 2016, http://www.latimes.com/business/la-fi-boeing-satellites-20160623-snap-story.html.

[109] Perlman, Benjamin, "Grounding U.S. Commercial Space Regulation in the Constitution," *Georgetown Law Journal*, 100 Geo. L.J. 929, March, 2012, p. 965.

launch complies with public health and safety considerations, international law and U.S. treaty obligations, and domestic national security interests.[110]

Depending on what the satellite does, it may run into regulations put in place by other agencies. Satellite use of the electromagnetic spectrum in outer space requires a license from the FCC to determine proper spectrum usage.[111] If the satellite is a private remote sensing system, it must be licensed through the National Oceanic and Atmospheric Administration (NOAA) within the Department of Commerce (DOC).[112] NOAA is tasked with making sure that any remote sensing done by private U.S. companies does not compromise national security or violate international obligations.[113]

The United States export control apparatus also controls what space technologies can be transferred to foreign countries or nationals. Because space technology can be used both for civil and military purposes, the United States does not want its capabilities falling into the wrong hands. Controlled technology is currently split between two lists separately maintained by the State Department (the International Traffic in Arms Regulations (ITAR)[114] and the DOC's Export Administration Regulations (EAR).[115] This system is complicated and can be difficult to navigate. Recent changes shifted some space technology from the stricter ITAR list to the looser EAR list, but ambiguities in the lists mean it can be difficult for companies to determine what approval they need.[116] Decisions made under the export regime can seem capricious, with similar parts controlled or not controlled depending on what industry they are produced for.[117] Because of the national security aspect of decisions, companies often never get a full explanation for decisions made.

Other than these main licensing areas, the rest of space has remained formally unregulated. The United States Air Force (USAF) keeps an eye on objects in orbit 10cm across or larger (though the commercial part of this "space traffic control" duty may be passed off to the DOT in the near future).[118] However, movement in orbit is not currently regulated, simply monitored. Outside of orbit, there are also no currently assigned agencies to provide regulation. Beyond launches, reentries, and some limits on capabilities and spectrum use, there is no regulation; nor is there a designated entity to produce potential regulatory proposals. There are national security decisions that play a role—such as restrictions on remote imaging quality, space situational awareness, and others—but these decisions

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[110] Federal Aviation Administration, "Licenses & Permits," https://www.faa.gov/about/office_org/headquarters_offices/ast/licenses_permits/.
[111] Federal Communications Commission, "Licensing," https://www.fcc.gov/licensing-databases/licensing.
[112] Ibid.
[113] National Oceanic and Atmospheric Administration, "About Commercial Remote Sensing Regulatory Affairs," http://www.nesdis.noaa.gov/CRSRA/index.html.
[114] U.S. Department of State, "The International Traffic in Arms Regulations (ITAR)," https://www.pmddtc.state.gov/regulations_laws/itar.html.
[115] Bureau of Industry and Security, "Export Administration Regulation Downloadable Files," https://www.bis.doc.gov/index.php/regulations/export-administration-regulations-ear.
[116] Foust, Jeff, "Despite Reforms, U.S. Export Control Rules Remain Complicated," *SpaceNews*, Nov. 1, 2014, http://spacenews.com/42430despite-reforms-us-export-control-rules-remain-complicated/.
[117] U.S. House of Representatives Small Business Committee, "Export Control Reform: Challenges for Small Business? (Part II)," *Hearing*, Feb. 11, 2016, https://www.youtube.com/watch?v=9uRZEXrmoss.
[118] Gruss, Mike, "Washington Weighs an FAA Role in Managing Space Traffic," *SpaceNews*, Dec. 3, 2015, http://spacenews.com/might-the-faa-inherit-the-space-traffic-management-role/.

are often up to the discretion of the official involved. However, more formal regulations may be on the way.

The current approach requires a launch licence for any commercial asset going into orbit. That means that there will be a *de facto* review of any mission beyond orbit. So far, a limited number of missions have been reviewed: Bigelow Aerospace module payloads (without a planned mission)[119] and the Moon Express rover mission. But Moon Express had to create a one-off application that worked its way through the Department of Defense, the State Department, NASA, NOAA, and the FCC for approval.[120]

The Moon Express application was successful and sets a precedent, but its *ad hoc* path to approval may not remain viable in the future. While commercial activities beyond orbit have been established as legal in the United States, the current process relies on opaque, discretionary decision-making within multiple agencies. It's difficult to trace such decisions back to individual officials, who have to consider national security and foreign policy decisions.[121] Without a formal process, firms have no way of knowing whether future missions will be permitted.[122] With so many agency stakeholders involved and an international obligation to authorize and supervise all private space missions, the U.S. government might lapse into *de facto* non-approval. It's easy to understand, then, why commercial space companies are concerned about regulatory uncertainty.[123] Industry concerns over the opacity and unpredictability of the mission approval process are likely to spur the government to consider new oversight mechanisms for the private exploration and use of outer space.

Future Areas of Regulation

In the medium- and long-run, new uses of outer space will place pressure on the U.S. government to craft new regulations. There may be some reforms to existing regulation—international development of remote imaging technology has reduced the United States' ability to demand limits on commercial remote sensing—but other areas will likely see regulations promulgated. Missions beyond Earth's orbit are one such area.

While the United States licenses and regulates launches, as well as in-orbit systems, it currently does not have a structure in place for beyond-orbit missions. Only one private company—Moon Express—has ever received permission to launch a mission beyond orbit, and it required a regulatory "patch" to get a positive payload review.[124] When more companies are able and willing to expand their presence beyond orbit, this patchwork system is unlikely to suffice. The government may have to

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[119] Foust, Jeff, "FAA Review a Small Step for Lunar Commercialization Efforts," *SpaceNews*, Feb. 6, 2015, http://spacenews.com/faa-review-a-small-step-for-lunar-commercialization-efforts/.
[120] Wall, Mike, "Moon Express Approved for Private Lunar Landing in 2017, a Space First," *Space.com*, Aug. 3, 2016, http://www.space.com/33632-moon-express-private-lunar-landing-approval.html.
[121] 51 USC Ch. 509: Commercial Space Launch Activites, http://uscode.house.gov/view.xhtml?path=/prelim@title51/subtitle5/chapter509&edition=prelim.
[122] Hampson, Joshua, "One Small Step Back to the Moon," *RealClearPolicy*, Aug. 24, 2016, http://www.realclearpolicy.com/articles/2016/08/24/one_small_step_back_to_the_moon_1699.html.
[123] Foust, Jeff, "Commercial Space Stations Face Economic and Regulatory Challenges," *SpaceNews*, Sept. 24, 2016, http://spacenews.com/commercial-space-stations-face-economic-and-regulatory-challenges/.
[124] Grush, Loren, "US government poised to approve first private mission to the Moon," *The Verge*, Aug. 2, 2016, http://www.theverge.com/2016/8/2/12275980/moon-express-private-mission-spaceflight-us-government.

create a transparent framework for approving licenses, or else open itself to possible accusations of favoritism.

At the moment, missions beyond Earth's orbit—to the moon or Mars, for example—are unmanned. Manned missions introduce another dynamic. Current regulation allows "informed consent" for spaceflight participants. This means that private companies can focus on regulations around launch systems and have passengers use waivers to acknowledge the risks. But this informed consent system currently only lasts until 2025.[125] Until then, the FAA is limited in the passenger regulations it can enact on the space industry.

Regulations on human travel, both in-orbit and beyond, will soon be an area of interest. If space tourism takes off, some types of space travel may become more similar to common carriers, such as atmospheric planes and ships, than experimental missions. If there are enough space tourism trips passing overhead, the U.S. government may be pushed to shift to a more hands-on regulatory approach.

There are parts of the space industry that are pushing for making the informed consent approach permanent.[126] They argue that there are several justifications for such a move, including: (1) the current system is working and fostering innovation; (2) the manned space market is still in early stages, and so needs protection from draconian regulation; (3) the manned space market is not monolithic, with newer systems like use of high-altitude balloons that are less mature than rockets or space planes; and (4) there are pronounced differences between in-orbit and beyond-orbit travel.[127]

At the same time, the pace of regulation will likely be attached to the pace of viable manned space travel. The next decade may see technological breakthroughs that greatly reduce costs. Companies like Bigelow Aerospace are working to create destinations for travelers into orbit and beyond.[128] It may not be that far in the future before regulators take a more heavy-handed approach to manned spaceflight. That approach will need to balance safety and innovation, and understand the nuances separating mature and developing technologies, as well as the different types of travel.

Space mining is another area of increasing interest for lawmakers and regulators. The 2015 U.S. Commercial Space Launch Competitiveness Act (CSLC) included language directed at facilitating commercial recovery of space resources by American citizens.[129] Plans to retrieve resources from space have their skeptics and proponents,[130] but there are those that seem intent on making space

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[125] United States Commercial Space Launch Competitiveness Act of 2015, https://www.congress.gov/114/plaws/publ90/PLAW-114publ90.pdf.

[126] MacCallum, Taber, " Opinion | Building a bright regulatory future for the commercial space industry," *SpaceNews*, Aug. 3, 2016, http://spacenews.com/building-a-bright-regulatory-future-for-the-commercial-space-industry/.

[127] Specifically, manned travel beyond orbit has increased risks from radiation. Any travel beyond orbit will have to deal with fuel issues, but will also be less crowded. *See generally* MacCallum, Taber, " Opinion | Building a bright regulatory future for the commercial space industry," *SpaceNews*, Aug. 3, 2016, http://spacenews.com/building-a-bright-regulatory-future-for-the-commercial-space-industry/.

[128] Bigelow Aerospac: https://bigelowaerospace.com/.

[129] United States Commercial Space Launch Competitive Act of 2015, https://www.congress.gov/114/plaws/publ90/PLAW-114publ90.pdf .

[130] David, Leonard, "Is Asteroid Mining Possible? Study Says Yes, for $2.6 Billion," *Space.com*, April 24, 2012, http://www.space.com/15405-asteroid-mining-feasibility-study.html.

mining a reality.[131] With the United States now recognizing citizens' rights to resources from asteroids or abiotic sources, once they have been obtained, it may appear that the regulatory issues are already handled. But that may not be the case. The 2015 Commercial Space Launch Competitiveness Act required a series of studies to look at American space activities and identify areas in which new authorities or licensing rules may be needed.[132] According to a letter from the Office of Science and Technology Policy to the Senate Committee on Commerce, Science, and Transportation and the House Committee on Science, Space, and Technology, "unprecedented commercial space activities" by American firms mean that the United States may not be fully in compliance with the Outer Space Treaty.[133] Due to this interpretation of the Outer Space Treaty, the Obama Administration began examining new mechanisms for oversight.

There is currently no established agency that would handle licensing for resource recovery missions. This may not be an issue for initial experimental missions, but the future may see strong competition between various private companies seeking the same sources of resources. There is also an issue of international law, and whether it compels the United States to be more specific about its regulation of private space companies. The OST makes nations responsible for space-based actions taken by its private citizens and companies.[134] If space mining becomes more viable, even if just to harness resources for use in space itself, there will likely be growing demand, domestically and internationally, for a coherent framework for claiming resources and interacting with other private actors. It may also be the case that current U.S. law suffices.

The international aspect of commercialization in outer space will be addressed more in depth later in this paper, but it does impact commercial space.[135] Companies looking to mine resources in space will likely pursue the easiest resources first, located on relatively close asteroids and possibly the moon. However, other countries could claim that American permission to its companies to own space resources violates the OST.[136] As the OST prevents claims of sovereignty—or national appropriation by any means—and nations are absolutely responsible for private companies' actions, other countries may be able to challenge the legitimacy of the CSLC.[137] At the same time, other countries are following the United States' lead and implementing national space mining laws,[138] arguing that recognizing property rights does not create an expansion of sovereignty into space. Luxembourg cites the

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[131] Planetary Resources: http://www.planetaryresources.com/.

[132] Office of Science and Technology Policy, "Reporting Requirement Contained in the U.S Commercial Space Launch Competitiveness Act," April 4, 2016, https://www.whitehouse.gov/sites/default/files/microsites/ostp/csla_report_4-4-16_final.pdf.

[133] Ibid.

[134] United Nations Office for Outer Space Affairs, *United Nations Treaties and Principles on Outer Space*, New York, 2002, http://www.unoosa.org/pdf/publications/STSPACE11E.pdf.

[135] Davies, Rob, "Asteroid mining could be space's new frontier: the problem is doing it legally," *The Guardian*, Feb. 6, 2016, https://www.theguardian.com/business/2016/feb/06/asteroid-mining-space-minerals-legal-issues.

[136] Davies, Rob, "Asteroid mining could be space's new frontier ...," *The Guardian*, Feb. 6, 2016, https://www.theguardian.com/business/2016/feb/06/asteroid-mining-space-minerals-legal-issues.

[137] The question at hand would be whether the awardance of property rights in space is merely a recognition of pre-existing rights, or undertaking a de facto expansion of sovereignty. That debate is beyond the scope of this paper, but the U.S. government may at least have an international incentive to *appear* to restrict space mining in the future, leading to a more hands-on regulatory approach.

[138] Jain, Rishabh, " Space Mining: Luxembourg's New Law To Give Private Companies Right To Outer Space Resources," *International Business Times*, Nov. 13, 2016, http://www.ibtimes.com/space-mining-luxembourgs-new-law-give-private-companies-right-outer-space-resources-2445432.

International Institute of Space Law in arguing that, "In view of the absence of a clear prohibition of the taking of resources in the Outer Space Treaty one can conclude that the use of space resources is permitted."[139] The OTS also left it up to individual nations to determine how to comply with its terms.[140] Of course, a significant determining factor in which interpretation wins out is to what extent states, particular major spacefaring nations, agree with either perspective.

While not new areas of regulation *per se*, laws surrounding orbital traffic, the use of the electromagnetic spectrum, and export controls may all see changes in the medium- to long-run as well. Satellite launching companies may come under more explicit regulations surrounding deorbiting practices and launch timings, given growing concerns over debris. Launches of cubesats—small, affordable satellites—may be catalytic drivers of these regulations, as their demand holds the potential to exponentially increase the number of satellites in orbit. Controls over the electromagnetic spectrum are likely to grow stricter as well, to ensure that this increase in satellites does not interfere with national security satellites or other private competitors. Export controls may be reduced as other countries catch up with American capabilities, but this is not guaranteed. A controversy in 1999 involving the transfer of American launch analysis technology to China led Congress to shift all satellite technology and related items away from EAR to ITAR—the stricter munitions list under the State Department.[141] While recent reform efforts have moved these technologies back to EAR,[142] a new controversy could see controls tightened again. Even with recent reforms, navigating the export control regime remains complicated and will likely remain a source of debate within both industry and government.[143] Significant technologies remain under ITAR.[144]

Of course, future U.S. regulations and laws surrounding space use and exploration will also be shaped by two large aspects of the space environment: national security considerations and international relations. Space has long since moved away from the bipolar Cold War dynamic to a much more complex multipolar system. The United States relies heavily on space assets for key military and intelligence capabilities, and other countries are quickly catching up. The interplay of national militaries, security regimes, and codes of conduct will play heavily into the future of commerce in outer space.

National Security

The importance of space capabilities to national security cannot be overstated. The U.S. military and intelligence community still exert large amounts of control and influence on outer space policy. There

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[139] Government of Luxembourg, "Did you know?" *Spaceresources.lu*, http://www.spaceresources.public.lu/en/did-you-know/index.html.
[140] Montgomery, Laura, "By the Outer Space Treaty's Own Terms, The U.S. Complies with Article VI of the Treaty," *Ground Based Space Matters, Law Offices of Laura Montgomery*, Dec. 17, 2016, http://groundbasedspacematters.com/index.php/2016/12/17/by-the-outer-space-treatys-own-terms-the-u-s-complies-with-article-vi-of-the-treaty/.
[141] Fishcer; Hutman, "U.S. Congress Authorizes Satellite Export Control Reform," *Pillsbury Law*, Dec. 21, 2012, http://www.pillsburylaw.com/publications/us-congress-authorizes-satellite-export-control-reform.
[142] Shane, John, "U.S. State and Commerce Departments Reform Export Controls Applicable to Satellites and Spacecraft Systems," *Wiley Rein LLP*, May 16, 2014, http://www.wileyrein.com/newsroom-articles-3161.html.
[143] Bureau of Industry and Security, "Export Control Reform Spacecraft/Satellites," July 28, 2014, https://www.bis.doc.gov/index.php/forms-documents/pdfs/1008-satellites-final-rules/file.
[144] Foust, Jeff, "Federal government tweaks space export control rules," *SpaceNews*, Jan. 12, 2017, http://spacenews.com/federal-government-tweaks-space-export-control-rules/.

are good reasons for this. The United States uses satellites for its nuclear command and control apparatus, military and intelligence surveillance, and national security communications and coordination.[145] Outer space is also becoming a more contested and dangerous national security environment.[146] For senior defense space experts, space is no longer perceived as a sanctuary.[147] If risks continue to propagate, the commercial outer space industry may see outer space become increasingly dangerous and controlled.

Defense of U.S. space systems is important, but the ability to do so will be complicated by space commercialization. There are several dynamics to space commercialization that will heighten national security concerns over outer space, including the number of actors involved in space, the growing crowdedness of outer space, and the increasing reliance on commercial providers for national security services. The first two issues tie into each other. The growing number of spacefaring countries and companies means that there are simply more satellites in orbit. From a defense perspective, this is a complication. To deter an attack on a satellite or degradation of systems capabilities, the United States needs to understand who the attacker is. In-orbit situational awareness is a must.

National satellites and equipment in orbit might be relatively easy to track, but if commercial companies flood Earth's orbit with thousands of new satellites, governmental tracking systems may not be able to adequately adjust. There is also the problem of determining whether a "private" satellite from another country is indeed privately-owned. In a world where soldiers have been disguised to prevent identification, a national satellite might be disguised as a commercial one.[148] Would the United States not be suspicious if a private Russian satellite caused a problem for an American national security satellite? For that matter, would Russia not be suspicious if a private American satellite caused problems for one of theirs? Additionally, private satellites might be hacked by non-state actors.[149] Attribution is an important issue, as the United States would be unable to respond to a problem without accurately identifying the responsible parties. Confusion over who is involved would slow response time, which would also degrade deterrence.[150] If American rivals can complicate attribution, they may take action that they would otherwise consider escalatory. By the time the United States assigns responsibility in this scenario, that rival might have been able to achieve a goal that would be difficult to roll back.

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[145] Stwarts, Phillip, "U.S. needs to defend space assets, Pentagon space expert says," *Air Force Times*, Jan. 29, 2016, https://www.airforcetimes.com/articles/us-needs-to-defend-space-assets-pentagon-space-expert-says.

[146] Billings, Lee, "War in Space May Be Closer Than Ever," *Scientific American*, Aug. 10, 2015, https://www.scientificamerican.com/article/war-in-space-may-be-closer-than-ever/.

[147] Marshall Jr., Tyrone, "Officials: Space no Longer a Sanctuary; Sequester a Threat," *DoD News, Defense Media Activity*, March 26, 2015, http://www.defense.gov/News/Article/Article/604366.

[148] Shevchenko, Vitaly, ""Little green men" or "Russian invaders"?" *BBC*, March 11, 2014, http://www.bbc.com/news/world-europe-26532154.

[149] Nakashima, Ellen, "Russian hacker group exploits satellites to steal data, hide tracks," *The Washington Post*, Sept. 9, 2015, https://www.washingtonpost.com/world/national-security/russian-hacker-group-exploits-satellites-to-steal-data-hide-tracks/2015/09/08/c59fa7cc-5657-11e5-b8c9-944725fcd3b9_story.html.

[150] Secure World Foundation; CSIS, "Space Deterrence Workshop Report," May 3, 2010, http://swfound.org/media/7176/space_deterrence_workshop_report_final.pdf.

This means that even with efforts to improve situational awareness,[151] commercial space companies may see growing restrictions on where satellites can be placed. The United States may wish to revisit ideas to restrict the number of objects close to its security satellites.[152] It may also restrict how close American non-governmental equipment can get to rival powers' sensitive satellites. It could be detrimental to international stability if a private U.S. satellite got too close to a Chinese or Russian spy satellite. Other countries may warn private companies away from certain orbital paths for the same reasons. Crowding in space is not yet an urgent issue, but it may be in the not so distant future. The interplay between commercial outer space and national security space will become harder to manage as more satellites begin populating orbital space.

Yet another issue is the U.S. government's increasing reliance on commercial space companies for national security services. Private companies have long been a part of outer space launches—ULA, for example—but the DOD is looking at possibly using commercial capabilities for satellite communications[153] and remote imaging.[154] There are also a growing number of private companies that have interests in space outside of government work. SpaceX wants to get to Mars. Bigelow Aerospace wants to build private and/or corporate space stations. Virgin Galactic wants to get tourists into space. Planetary Resources wants to mine asteroids for profit.

NASA and the U.S. military have contracts with some of these companies for launches.[155] In the future, however, the military and government agencies may be more heavily relying on commercial companies for launches, equipment, and services. If the commercial sector becomes a more influential part of the market than the government, as has happened in other areas of technological development, government priorities may take a lower priority to space companies than commercial priorities. In the long-run, this may have two effects: (1) commercial companies could become large enough to push back on policies they disagree with, similar to the Apple vs FBI encryption debate; and (2) as a result of this reliance, the U.S. government may shift from an open, innovation-fostering approach to space to a more controlled and regulated approach.

Complex national security issues could directly hinder commercial development of space. The national security apparatus in the United States, which can wield significant influence over the licensing process, may restrict actions in space to reduce some of these concerns. If conflict breaks out over space satellites and infrastructures, the actions the U.S. military may take could be purely based on military/intelligence strategy. This could directly damage commercial space assets, or indirectly make the space environment unviable for commercial launches or assets. It would be in the best interest of companies seeking to operate in outer space to pay close attention to the increasing tensions in outer space. Industry may be able to encourage de-escalatory action by the United States or avoid undertaking actions that may increase tensions themselves.

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[151] Wall, Mike, "US Air Force Launches 2 Military Surveillance Satellites," *Space.com*, Aug. 19, 2016, http://www.space.com/33800-air-force-surveillance-satellites-launch-afspc-6.html.
[152] Wohlstetter; Chow, *Self-Defense Zones in Space*, Pan Heurisitics, June 15, 1986, http://albertwohlstetter.com/writings/19860615-AW-Chow-SDZsInSpace.pdf.
[153] Gruss, Mike, "COMSATCOM Pathfinder funds withheld in Senate draft defense bill," *SpaceNews*, May 18, 2016, http://spacenews.com/comsatcom-pathfinder-funds-withheld-in-senates-draft-defense-bill/.
[154] Gruss, Mike, "Intelligence agencies announce new cooperation on commercial imagery," *SpaceNews*, July 17, 2016, http://spacenews.com/intelligence-agencies-announce-new-cooperation-on-commercial-imagery/.
[155] Gruss, Mike, "SpaceX wins $82 million contract for 2018 Falcon 9 launch of GPS 3 satellite," *SpaceNews*, April 27, 2016, http://spacenews.com/spacex-wins-82-million-contract-for-2018-falcon-9-launch-of-gps-3-satellite/.

The international issues in space are not exclusively security-centric. There are also legal and economic problems at play in the commercialization of outer space. During the Cold War, the United States and the Soviet Union worked to pass the OST. The OST helped tamp down concerns that either superpower would begin claiming parts of the moon or other planets. The treaty itself was also a compromise between the two ideologies in play. The Soviet Union did not want private ownership to extend into space, while the United States wanted to eventually unleash capitalism into the cosmos.[156] However, the primary concern was over military expansion and the possible terrestrial ramifications, and a deal was struck. Private actors and companies could go into space, but their launching nation would be responsible for their actions.[157] Not only would nations be responsible for private actors in space, but action taken in space by non-governmental entities would require the "authorization and continuing supervision" of their country.[158] This was codified in Article VI of the treaty.

For decades, this compromise did not pose any major challenges to American space exploration. Since that exploration was undertaken under national auspices and with national intentions, it made sense that the U.S. government would be responsible for any actions taken in space. Now, however, the private-public connection may become problematic as private actors pursue activities in space that have no direct public connection.

For example, it is unclear how the United States would manage disagreements between an American company undertaking moon exploration and another nation's moon exploration missions. What happens if another country grants licensing rights to a private company to harvest resources on the same asteroid that an American company has received licenses to mine? If an American private satellite crashes into a Chinese or Russian satellite, will the U.S. government honor its responsibility for its commercial space entities? Will the other country demand that the United States honor its signing of the OST and place tighter restrictions on its commercial space industry?

While the OST bans sovereign declarations over parts of the moon and other celestial bodies, it also prohibits the interference with other nations' space equipment. As recently pointed out in *The Harvard Gazette* by senior astrophysicist Martin Elvis, this non-interference protocol could allow valuable parts of the moon to be "claimed" anyway by nations or companies.[159] How would spacefaring nations deal with allegations that their companies were "hogging" parts of the moon? The United States has also ratified the Convention on International Liability for Damage Caused by Space Objects.[160] Under this convention, the United States may be liable for actions taken by private companies in space, depending on proof of fault. This potential liability may also constrain what the U.S. government is willing to tolerate from commercial space actors.

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[156] Koerth-Baker, Maggie, "Who Makes the Rules for Outer Space?," *PBS: Nova Next*, Nov. 30, 2015, http://www.pbs.org/wgbh/nova/next/space/space-law/.
[157] United Nations Office on Space Activities, *United Nations Treaties and Principles on Outer Space*, New York, 2002, http://www.unoosa.org/pdf/publications/STSPACE11E.pdf.
[158] Ibid.
[159] Powell, Alvin, "Eternal light, up for grabs," *Harvard Gazette*, July 12, 2016, http://news.harvard.edu/gazette/story/2016/07/eternal-light-up-for-grabs/.
[160] United Nations Office on Outer Space Affairs, *Convention on International Liability for Damage Caused by Space Objects*, Sept. 1972, http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introliability-convention.html.

This odd arrangement between allowing private action in space, but tying those actions back to a national accountability injects uncertainty into the international politics of outer space. Because countries ultimately "bear international responsibility ... whether such activities are carried on by governmental agencies or by non-governmental entities,"[161] there is a national incentive to control this uncertainty with regulation. As the U.S. government is the ultimate underwriter for the American space industry, it will come under increasing pressure to dictate the activity of that industry. This becomes more likely as the national security tension over outer space increases.

American commercial space companies have benefited from two checks on this regulatory pressure. First, many of the longer-term ideas for commercial space operations have only recently become viable. Asteroid mining, or commercial trips to the Moon, were long considered science fiction dreams. But with Moon Express' regulatory permission to send a private mission to the moon[162] and proposals for asteroid mining no longer laughed out of investment meetings,[163] whole new areas of space exploration and commerce no longer seem unviable.

Second, the commercial space industry has long had one dominant customer: the U.S. government. Even today, SpaceX has focused on breaking into the markets to launch USAF satellites[164] and has a major customer in NASA.[165] In the future, however, this may not be the case. Elon Musk has long made it clear that his end goal is to establish a colony on Mars.[166] Planetary Resources wants to mine asteroids for its own reasons,[167] and Moon Express wants to explore the Moon for "commercial lunar exploration and discovery."[168]

For now, these two checks have meant that the U.S. government has created a relatively permissive regulatory structure. The CSLC[169] was passed to incentivize American companies to push faster and harder to get into space. But as these dynamics change—as commercial use of space is normalized and as companies increasingly strike out on their own—the United States may quickly move away from this permissive environment. International tension might drive the government to consider whether the benefits from outer space are worth the terrestrial headaches. Disagreements in space may force its regulatory hand.

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[161] Koerth-Baker, Maggie, "Who Makes the Rules for Outer Space," *PBS: Nova Next*, Nov. 20, 2015, http://www.pbs.org/wgbh/nova/next/space/space-law/.
[162] Hampson, Joshua, "One Small Step Back to the Moon," *RealClearPolicy*, Aug. 24, 2016, http://www.realclearpolicy.com/articles/2016/08/24/one_small_step_back_to_the_moon_1699.html.
[163] The Economist, "Space: A Sudden Light," *The Economist: Technology Quarterly*, Aug. 25, 2016, http://www.economist.com/technology-quarterly/2016-25-08/space-2016.
[164] Gruss, Mike, "SpaceX wins $82 million contract for 2018 Falcon 9 launch of GPS 3 satellite," *SpaceNews*, April 27, 2016, http://spacenews.com/spacex-wins-82-million-contract-for-2018-falcon-9-launch-of-gps-3-satellite/.
[165] De Selding, Peter, " SpaceX wins 5 new space station cargo missions in NASA contract estimated at $700 million," *SpaceNews*, Feb. 24, 2016, http://spacenews.com/spacex-wins-5-new-space-station-cargo-missions-in-nasa-contract-estimated-at-700-million/.
[166] Wall, Mike, "Now Is the Time to Colonize Mars, Elon Musk Says," *Space.com*, Dec. 16, 2015, http://www.space.com/31388-elon-musk-colonize-mars-now.html.
[167] Planetary Resources: http://www.planetaryresources.com/.
[168] Moon Express, *U.S. Government Approves Plans for Moon Express to Become First Private Company to Venture Beyond Earth's Orbit*, Aug. 3, 2016, http://www.moonexpress.com/files/moon-express-press-kit.pdf.
[169] United States Commercial Space Launch Competitiveness Act of 2015, https://www.congress.gov/114/plaws/publ90/PLAW-114publ90.pdf.

In light of this, the U.S. government may try to thread the needle while mitigating international concerns. When the United States passed the Space Resource and Utilization Act, it did not include licensing rules for space mining—possibly because it could have been seen as the United States running roughshod over international norms.[170] The reality is that the regulatory environment for commercial space companies will not be truly predictable until the viability of their actions is demonstrated. At that point, a variety of international and domestic pressures will begin to weigh on how the U.S. government considers space commerce and regulation.

In the Future

All of these challenges need to be taken into account as the future of commercial outer space is considered. It is beyond the scope of this paper to provide in-depth policy recommendations, but there are some forward-looking steps that can be taken. If done responsibility, these actions could help mitigate current problems for commercial outer space while also responsibly positioning the United States for success in the future.

Part IV: Policy Recommendations

The continued growth of commercial outer space will rest on how the government is organized to engage with it, how the government does its own space business, and how the government allows and promotes private business in space. To that end, the following policy recommendations can help guide policymakers and their staffs in promoting this still nascent and increasingly important industry.

Organizational

One of the main questions facing the future of space commercialization is how the government will be organized to manage the expected changes. Will the system remain fragmented across agencies, or will it be consolidated into one? Will non-national security space situational awareness leave the USAF? Should anything change at all? These questions are not just important in themselves, but because good or poor organizational structures will shape *how* future decisions are made. Regardless of what policies are pursued, there are two organizational changes that the United States could make to benefit commercial outer space.

Elevate the Office of Commercial Space Transportation

First, the importance of outer space has outgrown the current organizational approach. The FAA AST does not have the clout it should have within the federal government. When the CSLA was passed in 1984, the authority of the FAA AST was not within the FAA—it was within the Office of the Secretary of Transportation. That office was only folded into the FAA in the 1990s[171] Now, space has become important enough to merit its own bureau within the DOT.

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[170] Koerth-Baker, Maggie, "Who Makes the Rules for Outer Space," *PBS: Nova Next*, Nov. 20, 2015, http://www.pbs.org/wgbh/nova/next/space/space-law/.

[171] Simberg, Rand, "Keep the FAA's Head in the Clouds: Why the Agency Should Not Be Regulating Space," *The New Atlantis*, June 10, 2016, http://www.thenewatlantis.com/publications/keep-the-faas-head-in-the-clouds.

Making FAA AST a separate DOT bureau would give it a larger voice in the government and improve its budgetary position. The move would also separate its mission—licensing commercial space operations and launches—from the FAA's broader mission to police the safety of the national airspace. The FAA generally deals with the mature airline industry, and focuses on safety. Space transportation is not yet a mature industry, and so the government agency that manages has to strike a more delicate balance between public safety and industry growth and development. Unlike the rest of the FAA, the FAA AST has a legislative mandate to promote commercial space. Space is also not directly comparable to airspace, as it requires significant international interaction and orbital positions are not "owned" by any particular nation. A separate administrator of space transportation would allow that reality to be reflected and would separate negotiations from space from terrestrial airspace concerns.

Having a separate sub-cabinet level for space could also alleviate growing pressures on the FAA. With growing responsibilities in a range of areas, the FAA has faced challenges with the increases in its space portfolio. A report from the Government Accountability Office (GAO) released in June 2016 found that the growth of commercial space launches have increased inspections from an annual average of 90 between 2006-2014 to 216 in 2015.[172] The FAA is also facing increases in new types of vehicles and technologies, new launch sites for inspections, and managing non-federal or commercial launch sites. All of this increases possible exposure for government liability, given current indemnification laws that place risks on the government for certain catastrophic problems.[173] As commercial space operations ramp up, the office that calculates possible government exposure, works to protect public safety, undertakes inspections, and handles international engagement will be increasingly strained. Additionally, the FAA will increasingly have to readjust how it allocates funds between its aviation and space obligations. Given the scope and maturity of the aviation industry, space may not receive the attention required. Organizationally, it makes sense to give FAA AST office the budgetary importance, authority, and presence to more effectively manage commercial space operations. Promoting FAA AST's position would also mean a clearer oversight from Congress, given the approval mechanism it holds for officials at the sub-cabinet level.

This move would also help delineate decisions involving beyond-orbit missions. While the FAA was involved in the recent payload review process of the Moon Express rover mission to the Moon, there are questions about exactly what authority it possesses for non-launch/reentry private action in space.[174] The debate that the Moon Express mission sparked involves unanswered questions about both domestic and international legality. Launch and reentry authority within the FAA initially made sense, given the FAA's oversight of national airspace. That logic becomes more and more strained the further one gets from that national airspace. The process that Moon Express had to go through to get permission was reminiscent of the *original* reason for the creation of the OCST (before it became FAA AST). In 1981, Space Services Incorporated (SSI) sought approval to launch its suborbital booster.[175] It quickly became clear that there was no specific agency with the authority to approve the launch, and SSI had to get permission from the FAA, NASA, and the State Department among others. Over the

[172] Dillingham, Gerald, *Commercial Space: Industry Developments and FAA Challenges*, United States Government Accountability Office, June 22, 2016, http://www.gao.gov/assets/680/677943.pdf.
[173] Dillingham, Gerald, *Commercial Space: Industry Developments and FAA Challenges*, United States Government Accountability Office, June 22, 2016, http://www.gao.gov/assets/680/677943.pdf.
[174] Klotz, Irene, "Exclusive - The FAA: regulating business on the moon," *Reuters*, Feb. 3, 2015, http://www.reuters.com/article/us-usa-moon-business-idUSKBN0L715F20150203.
[175] Fairman; Apern; Carr; Dean; Seidman, "Organization and Management Analysis of the Office of Commercial Space Transportation," *National Academy of Public Administration*, 1992.

next three years, when other companies requested launch permission, a dozen federal agencies had become involved in the process.[176] The same complexities seem posed crop up again with beyond-orbit or in-orbit missions.

A separate Bureau of Commercial Space Transportation would then be freer, both in culture and mandate, to promote commercial space missions in orbit and beyond. While the elevation itself would not determine *what* policies the United States would then pursue, the office itself could be shaped to more readily serve as a contact point for industry. At the moment, industry has to keep track of multiple FAA offices' policy positions. For example, the Air Traffic Organization (ATO) in the FAA has its own commercial space integration approaches.[177] These multiple offices do not always agree on policy approaches. Of course, commercial space launches need to coordinate with the wider national air space. Public comments and debate about how to approach that integration can be beneficial. But it should be clear to companies which government entity to turn to for a final ruling on policy. This would result in greater regulatory and legal certainty for space startups and the burgeoning commercial launch industry. The FAA AST and wider FAA already operate under different acts, so separating them would not require a complete legislative rework.

This change would not solve all of the organizational problems that exist within the United States' governance of commercial outer space. Commercial outer space rests on policies made across the government, not just the DOT. How the interagency process is managed will need review in its own right, particularly its transparency over *why* decisions have been made restricting commercial activities in space. While strengthening the promotion of commercial space launch is only one step in this process, it is an important step.[178] Any action in space first rests on getting into space. Strengthening the government entity tasked with promoting that access is necessary.

Space Situational Awareness

The United States needs to resolve its current commercial space situational awareness (SSA) problem. The USAF is currently managing national SSA, but may pass off the non-national security part of that task while continuing to focus specifically on military space assets.[179] The FAA has been highlighted as the possible agency in which to house commercial, civil, and foreign SSA—and has indicated that it is willing to take on that mission.[180] However, the same reasons that support elevating FAA AST out of the FAA are relevant in the SSA issue.

The FAA makes the argument that it is best positioned to handle the international aspect of SAA[181] —informing other countries of possible in-orbit collisions and managing global safety discussions—but outer space is an unusual nexus of national security, government activity, private commerce, and common heritage. The main spacefaring nations all rely heavily on space, or are ramping up space

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[176] Ibid.
[177] Davis, Bill, "ATO Commercial Space Integration," Space Traffic Management Conference: Emerging Dynamics, *Embry-Riddle Aeronautical University*, Nov. 18, 2016, http://commons.erau.edu/stm/2016/friday/6/.
[178] [redacted], "Commercial Space Industry Launches a New Phase," *Congressional Research Service*, Dec. 12, 2016, https://www.everycrsreport.com/files/20161212_R44708_a35133df2d936afd171d81bb13f6f60f4a89821f.pdf.
[179] Werner, Debra, "Congress gets report on giving FAA space traffic role," *SpaceNews*, Sept. 21, 2016, http://spacenews.com/congress-gets-report-on-giving-faa-space-traffic-role/.
[180] Ibid.
[181] Ibid.

infrastructure, for defense and intelligence operations. Countries without current space operations expressed concerns that the capability gap they face will increasingly widen, particularly if the main spacefaring nations lock in enviable orbits. This may make a FAA-styled approach increasingly difficult in the future. Even an elevated FAA AST may not be perceived as sensitive enough to other nations.

Situational awareness—though *not* orbit assignments, direct regulation, or licensing—might be best undertaken by a multi-stakeholder non-profit entity. A transition to such an entity would take longer than spinning off non-military SSA to the FAA, but would have several important advantages.

A non-profit, non-governmental entity, in separating the authority to license launches and that of monitoring civil, foreign, and commercial satellites, would be less open to accusations of American domineering in space. While the United States would still control its own operations in space, cooperation on SSA would be a symbolic outreach to other spacefaring nations. That could potentially open the number of countries, organizations, universities, and private groups willing to be involved in its SSA mission. As the mission of this private entity would be to simply warn nations and companies of possible collisions, it would not interfere with national or corporate interests in terms of launches. A non-profit, non-governmental SSA entity is not unprecedented. The Space Data Association pools data from participating commercial satellite operators.[182] However, for such an effort to be viable it needs buy-in from the U.S. government.

There are costs to such a system. The defense community would maintain its own catalog for protecting national security assets, and at least some of the data in such a non-government entity would come from civil agencies. Public funding would have to play a part. This duplication, however, may have lower costs than a civil agency like the FAA running the whole show. Non-governmental groups, such as research groups or companies, would have incentives to pick up some of the costs. Because current SSA capabilities rest on DOD investments, updates and new systems have been delayed lately.[183] Participation in a non-profit, non-governmental entity would allow companies speed that process by directly funding new tools and equipment. A recent Institute for Defense Analyses report found that non-governmental entities are already providing SSA services and may even surpass government capabilities for conjunction analysis in the near future.[184]

There are also concerns about such a system from the national security world. A non-defense SSA catalog—either in a civil agency or a non-government agency—could limit America's ability to protect sensitive missions and assets in space. While these concerns are legitimate, the reality is that the trend is moving away from secrecy in space. Actors outside the United States, such as the Space Data Association, are already working towards private space situational awareness.[185] Hobbyists can already track national security assets.[186] The situation is similar to what happened with encryption in

[182] Space Data Association, "SDA Overview," http://www.space-data.org/sda/about/sda-overview/.
[183] Lal; Picard; Weedon, "Approaches to Civil Space Situational Awareness (SSA)," *FAA Industry Day*, Oct. 25, 2016, https://www.faa.gov/about/office_org/headquarters_offices/ast/media/STPI_SSA_Industry_Briefing.pdf.
[184] Nightengale; Lal; Weedon; Picard; Eisenstadt, *Evaluating Options for Civil Space Situational Awareness (SSA), Institute for Defense Analyses: Science & Technology Policy Institute*, August 2016, https://www.ida.org/idamedia/Corporate/Files/Publications/STPIPubs/2016/P-8038.ashx.
[185] Weedon, Brian, "Time for the U.S. military to let go of □the civil space situational awareness mission," *SpaceNews Magazine*, September 12, 2016, http://www.spacenewsmag.com/commentary/time-for-the-u-s-military-to-let-go-of-%E2%80%A8the-civil-space-situational-awareness-mission/.
[186] Ibid.

the 1990s, and the United States faces either exporting private SSA capabilities to the rest of the world, or having an active role in how it takes shape.

On the other hand, there are national security benefits for promoting a non-governmental space situational awareness organization. The USAF would offload some of its costs. With better access to data, and increased engagement, the commercial sector would be better positioned to avoid problems in space. Commercial space entities involved with SSA may also be able to provide quicker updates to SSA capabilities. The USAF has already acknowledged that SSA can be done by non-state actors, recently awarding a contract to Applied Defense Solutions specifically to work towards a commercial augmentation of defense SSA.[187]

This movement of responsibility would allow the USAF to focus on monitoring and protecting American national security assets, becoming more focused in its situational awareness duties. The DOT—ideally via an elevated FAA AST—could focus on promoting commercial outer space and licensing missions. The non-profit, private SSA entity, free of international claims of bias or U.S. government control, but likely with a high number of American stakeholders, could focus purely on the best practices for distributing information on orbits and movements in space. Coordination would of course occur between the three sectors of the space environment, but the simplified missions would increase the likely of success for each and remove potential conflicts of interest.

How Government Does Space Business

The United States will also have to take a new look at how it does business. The U.S. government is a major customer both in space launch services and in-space services. As such, the way it awards contracts and purchases capabilities can deeply affect the viability of companies in the space economy. The U.S. government can take steps to ensure that its consumption of space services promotes the commercial market—primarily in terms of the commercial *launch* market.

Space Launch Market

The private launch industry has certainly made dramatic steps forward in recent years—especially with the progress of partially reusable rockets.[188] However, the government's share of the launch service market means federal policies still have an outsized effect on which companies survive in the market. Policies that made sense when there was one certified source for national security launches no longer make sense when there are competitors.

Of course, the United States military and intelligence services need to maintain their assured access to space. This is especially important in heavy-lift capability—the rockets that lift large, heavy national security satellites into orbit. However, as multiple companies develop new heavy launch capabilities,[189] even that market should be able to move towards healthy competition. There is a growing

[187] Swarts, Phillip, "U.S. Air Force awards commercial space-surveillance contract," *SpaceNews*, Oct. 31, 2016, http://spacenews.com/u-s-air-force-awards-commercial-space-surveillance-contract/.
[188] De Selding, Peter, " SpaceX's reusable Falcon 9: What are the real cost savings for customers?," *SpaceNews*, April 25, 2016, http://spacenews.com/spacexs-reusable-falcon-9-what-are-the-real-cost-savings-for-customers/.
[189] SpaceX, *Falcon Heavy* http://www.spacex.com/falcon-heavy. Clark, Stephen, "Details of Orbital ATK's proposed heavy launcher revealed," *Spaceflight Now*, May 27, 2016,

opportunity to help push launch markets into the type of market competition that will continually produce innovation solutions for both commercial and government clients. It will require changes to how the government buys launch services.

The DOD and USAF should review their current contracts and policies for launch services. Direct support for infrastructure and capacity, while useful during the era of single-sourced launches, should be responsibly phased out.[190] The launch industry is no longer in the same fragile state that merited contracts for such support,[191] and in a competitive market propping up infrastructure helps neither entrants to the market nor the incumbents. The incumbent is not incentivized to innovate the next generation of technology because the support rests on maintaining the current infrastructure and capability, and entrants are handicapped by not receiving infrastructure support.

These are not new arguments. In the 1990s, the USAF shifted to purchasing launch services from commercial providers.[192] The government had anticipated an increase in demand from the commercial space market that would, after initial development funding from the government, help pay for the commercial providers' launch systems.[193] That demand did not materialize, and spiraling costs eventually forced the two providers to merge into ULA.[194] The question today is whether the demand for launches has changed enough to merit a new attempt at promoting competition, or if a repeat of the challenges of the 1990s is likely.

There are substantial differences today that may make a competitive launch market more viable, however. First, the rise of new market entrants has increased the potential for competition. While these new entrants have needed government contracts and development support, they did not begin as projects pitched by the government to traditional government contractors. Selling to the commercial market was part of the calculus from the beginning. That calculus meant focusing on driving costs down, even though that increases potential risk.[195] Those lower costs, though, broaden the potential commercial market by increasing access to launch services. The industry has seen a rise in interest in low-cost satellites, driven by entities that had been priced out of the traditional market.[196] Instead of focusing on providing a 100 percent reliable launch service first, and then reducing costs to appeal to commercial launches, these new launch entrants have started by focusing on competitive costs and then building up the track record for reliability.

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https://spaceflightnow.com/2016/05/27/details-of-orbital-atks-proposed-heavy-launcher-revealed/. Bennet, Jay, "Blue Origin Announces Huge Heavy Lift Rocket to Rival SpaceX's Falcon 9," *Popular Mechanics*, Sept. 12, 2016, http://www.popularmechanics.com/space/rockets/a22813/blue-origin-announces-new-glenn-rocket/.

[190] Gruss, Mike, "U.S. Air Force evaluating early end for ULA's $800 million in yearly support," *SpaceNews*, Jan. 27, 2016, http://spacenews.com/u-s-air-force-looks-at-ending-ulas-launch-capability-payment/.

[191] Smith, Marcia, "Hyten: No "Fair Competition" If ULA Contract Remains," *SpacePolicyOnline* April 7, 2015, http://www.spacepolicyonline.com/news/hyten-no-fair-competition-if-ula-contract-remains.

[192] Maj Gregory Wood, USAF, "The Evolved Expendable Launch Vehicle," *Air & Space Power Journal*, Summer 2006, http://www.au.af.mil/au/afri/aspj/airchronicles/apj/apj06/sum06/wood.html.

[193] Ibid.

[194] Ibid.

[195] Berger, Eric, "ULA executive admits company cannot compete with SpaceX on launch costs," *Ars Technica*, March 17, 2016, http://arstechnica.com/science/2016/03/ula-executive-admits-company-cannot-compete-with-spacex-on-launch-costs/.

[196] [redacted], "Commercial Space Industry Launches a New Phase,"*Congressional Research Service*, Dec. 12, 2016, https://www.everycrsreport.com/files/20161212_R44708_a35133df2d936afd171d81bb13f6f60f4a89821f.pdf.

That is not to say that the DOD and USAF could not provide some support to the wider market for needs currently unmet. For heavy launch systems, for example, the DOD should continue to use public-private partnership contracts to incentivize investment. This is what it has done in working with Orbital ATK for new engine development, for example.[197] Those contracts, paid for direct development of a service, do not skew the markets as much as payments for capacity do. It is also important, though, that if the government does need to award funds for a required capability, that it does so across the industry. Any firm that receives sole support from the government would gain an unfair advantage in both the market for government contracts, but also in the wider commercial market. The government must be careful to not play favorites.

Where possible, the government should purchase services instead of building its own systems. For this to be properly competitive, the government will need to use the same contract types for the bidding companies. At the moment, the certified defense launch companies operate under two different types of contracts.[198] This results in different cost burdens due to varying requirements under the contracts. Before the launch industry recently became competitive, the USAF used cost-reimbursement contracts. These contracts required intensive reporting from ULA, the only certified launch company, to ensure fair prices.[199] With nascent competition in launch services, fixed-price contracts could be used and the reporting requirements rolled back. The USAF will lose significant information it has on the internal workings of the companies providing launch,[200] but the decision would be fairer across the two currently certified launch companies and lower a significant barrier to entry.

With lower barriers to entry, the odds of a robust and competitive commercial launch market increase. Such a market would lower costs of launch, reducing access for more commercial actors and lowering prices for government agencies. The type of innovation already seen in space would be furthered, as would the growth of the U.S. space economy. At the same time, the ability for the United States to quickly launch new defense systems, or reconstitute existing systems, would be strengthened.

None of these steps will be easy, and the launch market is perhaps the most difficult area of the space economy for the government to manage. The United States has to promote competition (not just for competition's sake, but to reduce costs and spur innovation), while also maintaining confidence that it has two ways of accessing space. While the launch market is more competitive than it has been, there are also substantial challenges. One defense-certified launch vehicle relies on Russian-built rockets,[201]

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[197] Clark, Stephen, "Orbital ATK, SpaceX nab U.S. Air Force propulsion contracts," *Spaceflight Now*, Jan. 14, 2016, https://spaceflightnow.com/2016/01/14/orbital-atk-spacex-nab-u-s-air-force-propulsion-contracts/.

[198] SpaceX was awarded a fixed-cost contract (*see generally* Messier, Doug, "Air Force Awards GPS III Launch Services Contract to SpaceX," *Parabolic Arc*, April 27, 2016, http://www.parabolicarc.com/2016/04/27/air-force-awards-gps-iii-launch-services-contract-spacex/.); Alternatively, ULA operates under a cost-reimbursement contract. (*see generally* U.S. Government Accountability Office, *Evolved Expendable Launch Vehicle: The Air Force Needs to Adopt an Incremental Approach to Future Acquisition Planning to Enable Incorporation of Lessons Learned*, Aug. 11, 2015, http://www.gao.gov/products/GAO-15-623.)

[199] U.S. Government Accountability Office, *Evolved Expendable Launch Vehicle* ..., Aug. 11, 2015, http://www.gao.gov/products/GAO-15-623.

[200] Ibid.

[201] United Launch Alliance, Atlas V: Maximum Flexibility and Reliability, http://www.ulalaunch.com/products_atlasv.aspx

one is no longer commercially viable,[202] and the newest has also had its issues.[203] The United States has to promote new options to replace its older launch vehicles, but in doing so could skew the market and kill of entrants. Fundamentally, however, a successful transition to new, affordable launches will rely on a competitive market being maintained.

Non-Launch Services

The promotion of commercial outer space should not just focus on launch services, but also in-orbit tools such as communications and remote sensing. The U.S. government has the opportunity to use burgeoning commercial capabilities in those markets as well, but it should make it easier for Americans to invest and compete in them.[204]

It is also important to remember that commercial demand for launch services will be vital to future development of cheaper, more innovative launch services. Commercial actors already control over 70 percent of the market, and that number will likely increase.[205] Low launch costs are fueling a surge in investments in space-related business, and those investments will fuel more lanches.[206] The money that launch companies will get from companies wanting to put satellites, or other assets, into space will fuel improvements to launch services and further reduce costs. This virtuous cycle will have two effects: (1) America's space economy, and so its wider economy, will grow; and (2) innovations in launch services that are cheaper, but riskier, will be tested in the commercial sector and can then be used for government launches when proven safe.

The DOD has already argued that working with commercial providers for needed services has benefits. Tying commercial assets into defense systems can reduce costs and strengthen defense capabilities by reducing the likelihood that vulnerabilities in a system are replicated across the entire network.[207] If the United States can then purchase a range of commercial in-orbit tools, or piggyback hosted payloads on commercial satellites, it may further drive progress in the commercialization of outer space. Competition for providing in-orbit services would increase, reducing costs, and launch prices may fall with even higher demand for launches.

How Government Allows Space Business

Finally, the United States also needs to look at how it allows space business to be conducted. Organizational changes may allow the government to be better positioned to consider policies and regulation, and government business reforms may ensure that markets are not skewed too much.

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[202] Mehta, Aaron, "ULA to Retire Delta IV, Push for More RD-180s," *DefenseNews*, March 15, 2015, http://www.defensenews.com/story/defense/air-space/space/2015/03/15/ula-delta-iv-retire-rd180-russia-spacex/70231994/.

[203] Klotz, Irene, "SpaceX Finds Rocket Explosion 'Smoking Gun,'" *Space.com*, Nov. 7, 2016, http://www.space.com/34641-spacex-elon-musk-falcon-rocket-explosion-launch-pad-accident.html.

[204] CSIS, "The U.S. Military and Commercial Space Industry," October 24, 2016, https://www.csis.org/events/us-military-and-commercial-space-industry.

[205] The Space Foundation, *The Space Report: The Authoritative Guide to Global Space Activity*, 2016, http://www.spacefoundation.org/sites/default/files/downloads/The_Space_Report_2016_OVERVIEW.pdf.

[206] Masunaga, Samantha, "Why investment in space companies is heating up," *Los Angeles Times*, July 7, 2016, http://www.latimes.com/business/la-fi-qa-space-investment-20160707-snap-story.html.

[207] CSIS, "The U.S. Military and Commercial Space Industry."

Responsible policies, however, will be the most important aspect of healthy commercial space market.

The United States benefits from promoting as large a space economy as possible. Such an economy would drive innovation and promote growth. For the government, a freestanding space economy would drive down costs of launches and services. How then should the government approach its space regulations? While the commercial space market is perhaps in a better shape than it ever has been, it still is relatively fragile.[208] While this paper has mentioned the various pressures that are growing on the U.S. government to review its space regulation, those pressures themselves do not mean that the United States should regulate for regulation's sake. For example, in some cases the solution may simply be clarifying the decision process and enabling a review process.

In approaching commercial space, government agencies should take as light-touch an approach as possible. Missions should be default-approved, with the burden of proof on the government to demonstrate that a particular mission would be risky to the public or national security. If within a standard period of time the government cannot articulate a specific reason as to why the mission should not move forward, it should be permitted. The application process for missions should be clearly articulated, and decisions should be consistent across applications from different companies. Informal processes should be formalized. Decisions made for national security reasons should at least be traceable, in case review is necessary.

There should also be a public review process for challenging decisions. The remote sensing industry is an example of what can happen when overly burdensome regulations are put into place: American businesses are handicapped and industry advantage shifts to foreign competitors. In this regard, current policies that are archaic should also be revisited. The licensing process for remote sensing, for example, has been criticized as arbitrary.[209] The result, at least from the commercial viewpoint, has been that non-governmental remote sensing is provided mostly by non-American companies.[210] The review of the export control system should also continue, with regular updates.[211] The specificity of the restrictions means that they can become obsolete quickly, with non-American companies producing equipment American companies are constrained from selling abroad. In reviewing these processes and systems, the goal should be that the space market becomes self-supporting rather than a simple privatization of government tasks.[212]

The government can also avoid creating regulations to manage issues that could be managed under existing law. It is possible, for example, that tort law could be used to manage some of the possible issues of outer space, at least in issues between two American companies. Outer space is not a single policy area which requires a one-size-fits-all approach. There are a range of issues with a range of analogs in existing domestic and international law, and there will be a range of potential solutions to those particular issues. Space mining may be analogous to deep sea exploration, while debris clean-up

[208] Dorminey, Bruce, "NewSpace Sector Is Likely Facing Recession," *Forbes*, Nov. 15, 2016, http://www.forbes.com/sites/brucedorminey/2016/11/15/newspace-sector-is-likely-facing-recession/#48dc4a4ed09a.

[209] Foust, Jeff, "House panel criticizes commercial remote sensing licensing," *SpaceNews*, Sept. 8, 2016, http://spacenews.com/house-panel-criticizes-commercial-remote-sensing-licensing/.

[210] Ibid.

[211] Foust, Jeff, "Federal government tweaks space export control rules," *SpaceNews*, Jan. 12, 2017, http://spacenews.com/federal-government-tweaks-space-export-control-rules/.

[212] CSIS, "The U.S. Military and Commercial Space Industry."

in orbit would require international agreements and coordination. Maturity levels of different parts of the industry will also inform different approaches.

Regulations, if found to be necessary, should be consistent, unambiguous, and specific. The process for rulings on decisions should be transparent and consistently applied. The government should avoid using catch-all categories and should instead specifically draft the rules for individual activities in space if needed. The government should also remember that the OST is not self-executing. Although there could be international consequences for decisions made about whether to regulate an activity in space or not, the United States has leeway in determining what needs authorization and how intensive "continuing supervision" needs to be.[213] The United States also should not try to guess what commercial uses of outer space may become viable or not. It is important to remember the lesson of AT&T's 1960 license application: the commercial sector may surprise the government in what the latter believes to be viable.[214]

Because of Article VI mandate in the OST and the complexity of the issues at play, avoiding burdensome regulation is the hardest policy suggestion. The mere presence of complexity, however, does not mean that the government should err on the side of overly restrictive policies, especially when the benefits to liberalizing the regulations in this industry are so pronounced.

Conclusion

This recommended list of actions does not exhaust the possibilities for how the U.S. government can promote commercial outer space. New and complex problems will certainly arise in the future. For now, these proposals can help the United States realize the full potential of outer space for private actors and the government alike. Elevating space policy to a higher level within the government, codifying an attitude of openness to innovation, and making sure that any regulations—if needed—are up-to-date, clear, and reliably applied are key to realizing the benefits of space.

A growing and robust commercial space economy will facilitate economic growth and promote domestic national security. The same incentives that drive innovation in the competitive, commercial sector will, over time, reduce the costs and increase the capabilities of American security space systems. Innovations in satellite technology will change how parts of the economy operate, and how the U.S. military projects power abroad. Cheap launch services can open Earth's orbit and beyond to larger markets, eager entrepreneurs, and new inventors. Those services could also allow the United States to create a more resilient defense network in orbit and, if necessary, quickly reconstitute it.

There are many challenges that stand in the way of that market—from the sheer difficulty of going to space to the geopolitical and legal complexities involved—but now is the time to get serious about crafting good space policy. The decisions in the next couple of years could define access to space, and the benefits we reap, for generations to come. The United States must decide between a risk-averse approach—restraining the market and ceding exploration and investment to more adventurous

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[213] United Nations Office on Space Affairs, *United Nations Treaties and Principles on Outer Space*, United Nations, 2002, http://www.unoosa.org/pdf/publications/STSPACE11E.pdf.

[214] Whalen, David, "Communications Satellites: Making the Global Village Possible," *NASA History Division*, Nov. 20, 2010, http://history.nasa.gov/satcomhistory.html.

nations—and an optimistic and permissive approach, with intervention only when it is clearly necessary.

The rise of a commercial space market will not necessarily be uneventful. There will be failures, and some of the optimistic companies that exist today will succumb to competitors or the difficulty of the task at hand. Investments in space will ebb and flow.[215] But there will be no groundbreaking innovation if we refuse to tolerate failures and allow the market to mature. Public safety, especially for launches, must remain a concern, but that does not have to come at the expense of promoting growth and defending national security.

The United States is on the cusp of having an independent commercial space market. With a few smart decisions and a policy of regulatory restraint, the government can simultaneously promote innovation, growth, and national security, while proving that enterprise in space does not require the backing of a large nation state. That would be a giant leap for mankind.

[215] Dorminey, Bruce, "NewSpace Sector Is Likely Facing Recession," *Forbes*, Nov. 15, 2016, http://www.forbes.com/sites/brucedorminey/2016/11/15/newspace-sector-is-likely-facing-recession/#1485c9bcd09a.

Afterword

Late last year, Elon Musk presented his long-awaited plan detailing a manned mission to Mars. It was technically-informed, daring in its truncated timeline, and just a little bit audacious. In short, it was everything we've come to expect from the man. As Musk concluded his presentation, he argued we should all be dreaming just a little bit bigger. "Life needs to be more than just solving problems every day," he said. "You need to wake up and be excited about the future." With all the exciting recent developments in the space industry, those words are an inspiring call to action.

Musk's plan is a bold undertaking and its success is far from guaranteed. Yet in the shadow of the Tesla tycoon's grandiose aims lies an assuredly actualizable goal: the commercialization of space.

The legal, regulatory, and international challenges ahead are surmountable, but we should not be under any illusion that it will be an easy path ahead. We will need to establish a clear regulatory framework to ensure certainty and accountability in order to grow investment and spur further innovation. National security considerations will be of paramount importance, lest the specter of space-based conflict leaves this burgeoning marketplace grounded. The international implications of near-Earth orbit competition will necessitate greater cooperation between commercial launch providers, space-based service firms, and, perhaps most importantly, nation-states. What is needed now, more than ever, is a serious and committed partnership between governments, nonprofits, and industry players the world over.

Here in the United States we can play a significant role in catalyzing that partnership. The U.S. government should venture to promote a closer working relationship between the emerging commercial launch industry and national security stakeholders. By first ameliorating domestic concerns, our country can take the lead in unlocking the final frontier for all of humanity. And in the wake of the aperture we open, others will surely follow.

Luckily, much of the groundwork has already been laid for what lies ahead. SpaceX, Orbital ATK, Blue Origin, Virgin Galactic, Moon Express, and other visionary companies have already set the stage for our journey to the wider solar system. Nurturing this ecosystem of emerging space launch competitiveness and bringing down launch costs will be the first step in this longer journey, and we're already well on our way.

While starry-eyed optimism can keep the ultimate goal of commercializing, colonizing, and conquering space in focus, we must bear in mind that such a realization remains on the horizon. The barriers here are real and significant. With such a daunting task ahead, we should move forward with clear goals and clear heads—dreaming big and embracing the exciting potential before us, while taking it one sober, practical step at a time.

This paper, and the recommendations it outlines, is one such step towards moving the private space sector onto more solid ground. By promoting the Office of Commercial Space Transportation to a sub-cabinet administrative unit, the U.S. government can communicate its commitment to the importance of the commercial space sector and help create the legal and regulatory certainty necessary to catalyze further investment and innovation. Handing commercial space situational awareness to a nonprofit organization with a globally-focused multi-stakeholder arrangement can

help alleviate international concerns. It would also deflect criticisms of American hegemonic expansion into space while helping to dutifully address international space-based coordination issues.

There are still many hurdles to overcome and we must be mindful of them. Yet we shouldn't let that reality temper our optimism, nor lead us to exuberantly embrace the status quo at the cost of welcoming the future. We should be excited about the possibilities of becoming a true multi-planetary, space-faring species. Humanity's future lies amongst the stars. It's up to us to figure out the best path to get there so that all of us may share in the common heritage of mankind. If we can get the rules right, the sky will no longer be the limit.

Ryan Hagemann
Technology and Civil Liberties Policy Analyst
Niskanen Center

CLEVELAND-MARSHALL COLLEGE OF LAW

Prof. Mark J. Sundahl

March 6, 2017

The Honorable Brian Babin
Chair, Subcommittee on Space
United States House of Representatives

The Honorable Mo Brooks
Vice-Chair, Subcommittee on Space
United States House of Representatives

The Honorable Ami Bera
Ranking Member, Subcommittee on Space
United States House of Representatives

Re: Space Subcommittee Hearing (March 8, 2017)
Regulating Space: Innovation, Liberty, and International Obligations

Dear Chairman Babin, Vice-Chairman Brooks, and Ranking Member Bera,

I am writing to strongly recommend that the Subcommittee support the enhanced payload review approach (the "**EPR approach**") to regulating non-traditional space activities as proposed in the *American Space Renaissance Act* (H.R. 4945, Sec. 309).

By way of background, I hold the *Charles R. Emrick, Jr. – Calfee, Halter & Griswold Chair of Law* at Cleveland State University, where I teach Space Law and International Business. I also currently serve as chair of the COMSTAC's *International Space Policy Working Group.*

In short, the need to adopt the enhanced payload review is required to fill the regulatory gap that currently exists in U.S. law regarding non-traditional space activities. This regulatory gap likely violates the United States' obligation under Article VI of the Outer Space Treaty that member states "authorize and continually supervise" the activities of their nationals. ***However, the need to adopt the bill is equally driven by industry demand for regulatory clarity, among other considerations.*** I ask that the Subcommittee consider the items explained in the following bullet points. These items are discussed in greater detail in an article I recently wrote for the journal *Air & Space Law.*[1]

[1] Mark J. Sundahl, *Regulating Non-Traditional Space Activities in the United States in the Wake of the Commercial Space Launch Competitiveness Act*, 42:1 AIR AND SPACE LAW 29 (2017).

- **There is currently a "regulatory gap" regarding non-traditional space activities that, if not remedied, will likely result in a violation of the Outer Space Treaty**: No governmental agency currently has jurisdiction over the in-space activities of "non-traditional" private space activities (e.g. on-orbit satellite servicing/refueling, lunar activity, orbital space stations, and asteroid mining). "Traditional" space activities (launch services, telecommunications, and remote sensing) are fully regulated. The FAA licenses launch and reentry, the FCC licenses radio spectrum and orbital slot allocation, and NOAA regulates remote sensing. No agency has been given authority by Congress to regulate non-traditional activities. This regulatory gap is likely to be found by our international partners to violate Article VI of the Outer Space Treaty.

- **U.S. industry needs regulatory clarity:** The existing regulatory framework does not work for those companies developing non-traditional space missions. Over the past two years, the FAA has been courageously leveraging its authority in ways that exceed the traditional limits of its jurisdiction – and has been doing so in order to allow companies to move forward *despite the lack of a regulatory structure that fits their missions.* The recent Moon Express payload review determination is a perfect example. The FAA's positive determination was laced with words of discomfort and caution (*e.g.*, that the determination would not serve as precedent and that future applications would be dealt with on an *ad hoc* basis). This type of language (for which the FAA should not be blamed given current limits on its jurisdiction) clouds the regulatory certainty that is needed by companies and their investors.

- **U.S. industry has expressed its strong support for the EPR approach:** The COMSTAC issued the following recommendation in support of the EPR approach:

  > *COMSTAC recommends that, in meetings and discussions with policymakers, the FAA should advocate for the Office of Commercial Space Transportation to be the lead organization to conduct "enhanced payload reviews", as generally described in the American Space Renaissance Act (H.R. 4945, Sec. 309), in order for the U.S. to meet its international treaty obligations and ensure safe and successful implementation of domestic commercial space activities.*

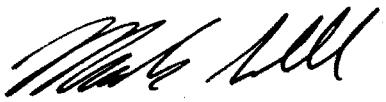
- **The EPR approach is not burdensome and in some respects improves upon the efficiency of the existing payload review process:** The ECR approach is not burdensome to companies. It is modeled on the long-existing payload review that is currently in place. It simply expands the jurisdiction of the FAA to cover non-traditional activities. In fact, rather than imposing new burdens, the ECR approach streamlines existing regulations and provides other benefits to industry (such as setting a strict timeline for agency responses and allowing for non-prejudicial denials so that companies can reapply for a determination after responding to agency concerns).

- **The U.S. should take the lead in the regulation of non-traditional space activity (or risk pushing companies overseas):** This is an opportunity for the U.S. to take the lead and set the standard internationally regarding how to regulate non-traditional space activity under the Outer Space Treaty. If the U.S. does not act, then other countries will. And it may be to the detriment of U.S. companies. The list of countries that have been aggressively legislating in order to attract space companies is growing quickly and now includes, among others, the UK, Luxembourg, the UAE, Italy, Sweden, Japan, and Curacao. Companies will seek out those countries with regulatory clarity if the U.S. does not provide it.

- **The Subcommittee should be aware of the following red herrings:**
  - *That the Outer Space Treaty is non-self-executing*: Witnesses may raise the point that the Outer Space Treaty is non-self-executing. This is a true statement, but it does not affect this debate. Regardless of the fact that the treaty is non-self-executing, the U.S. nevertheless has the international obligation under the treaty to authorize and supervise this activity.
  - *That the obligations of the Outer Space Treaty does not apply to private activity*: Witnesses may argue that the Outer Space Treaty obligations do not apply to private space activity. Of course, international law does not apply directly to private individuals and companies. But the treaty does require that the U.S. enact regulations that requires companies to comply with the treaty obligations (e.g., not to put weapons of mass destruction into orbit, not to interfere with activities of other states without prior diplomatic consultation, etc.).

Thank you for taking this letter into consideration. I am pleased to provide any further information, if needed. I can be reached at 216.526.2458 or *m.sundahl@csuohio.edu*.

Respectfully submitted,



Mark J. Sundahl, J.D., Ph.D.

DOCUMENT SUBMITTED BY SUBCOMMITTEE
RANKING MEMBER AMI BERA

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March 17, 2017

Rep. Brian Babin
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Rep. Ami Bera
Ranking Member, Space Subcommittee
Committee on Science, Space & Technology
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Washington, DC 2003

Subject: Letter for the record for the hearing on "Regulating Space: Innovation, Liberty, and International Obligations."

Dear Chairman Babin and Ranking Member Bera:

The Secure World Foundation (SWF) is dedicated to ensuring the long-term sustainable use of space for benefits on Earth. We believe that the development of new and enhanced space capabilities is critical to addressing many of the challenges we face on Earth, and improving the lives of all humanity. As such, SWF has a keen interest in the topics discussed at the hearing organized by your subcommittee on March 8, 2017. We submit the following letter in support of the subcommittee's deliberations.

The space domain is currently undergoing rapid changes. An increasing number of countries are building and operating their own satellites for a variety of reasons, including to promote national pride, to foster science, technology, engineering, and mathematics (STEM) education, or to kick-start their own commercial space sector. At the same time, billions of dollars in public and private capital are flowing into dozens of space start-up companies. Some of these start-ups are bringing innovation and expanding capabilities to existing commercial space sectors, such as communications and remote sensing. Others are trying to build or expand commercial markets in launch services, human spaceflight, and exploration, which historically have been the domain of governments. Still others are venturing into activities such as asteroid mining that have never been done, and hold significant promise.

These changes have both positive and negative implications. On the positive side, the changes are leading to greatly increased innovation, lowering of costs, and greater access to beneficial satellite services for everyone. However, the growth and diversification of space activities and the influx of new actors also has the potential to exacerbate many of the current challenges to the long-term sustainable use of space, including: on-orbit crowding, radio-frequency interference, the proliferation of space debris, and the chances of an incident in space sparking or escalating geopolitical tensions and conflict on Earth.

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We believe it is critical for the United States to establish an appropriate oversight framework that encourages commercial space activities and innovation, while also mitigating against the worst negative externalities that could result from unchecked and irresponsible behavior. We encourage Congress to consider a middle ground approach between burdensome over-regulation and a complete laissez-faire approach, either of which would stifle increasing space activity and innovation. Both the government and the private sector have important roles to play in ensuring the long-term sustainability of space, and that the eventual solution needs to incorporate the best capabilities of both.

Much of the current debate on this issue is focused on whether the United States has a legal obligation under Article VI of the 1967 Outer Space Treaty to authorize commercial space activities, and how that obligation is implemented. While the legal aspects are critical, the decision on how to provide national oversight of space activities cannot be based solely on legal opinion. There are other important factors such as national security, economics, and geopolitics that must be taken into account in making such an important public policy decision.

The United States can use this opportunity to enhance its leadership role in the international community on space governance. Many countries have established, or are in the process of establishing, national policy and regulation for space activities. Historically, other countries have modeled their national policy and regulation on the example provided by the United States. Thus, how the United States approaches the current issue could have widespread international implications. If the United States adopts an approach that undermines the rule of law and national obligations under the Outer Space Treaty, it would likely have a negative impact on the interests of the United States and the international legal framework it has helped develop over the last sixty years. Moreover, an approach that provides unfettered freedom of access for private sector entities could create risks for U.S. commercial companies in the future, particularly from foreign competitors. As more countries acquire the capability to engage in commercial space activities, it will be important for U.S. companies to be working inside a predictable international legal framework that can encourage and protect investments.

With these goals and concerns in mind, SWF believes that the following areas are priorities for a future U.S. oversight framework:

1. **Reduce national security restrictions.** Nearly all the existing regulatory burdens and constraints on U.S. commercial space activities stem from national security restrictions. Export controls on satellites, mainly put in place over fears of technology transfer to China, have already caused the U.S. space sector to lose a significant portion of global market share. Several categories of remote sensing and on-orbit activities are heavily restricted, or, in some cases, have been off limits for U.S. commercial entities, enabling foreign competitors to leap ahead and establish global markets. Reducing these national security restrictions would go a long way towards lessening the burden on the commercial sector, supporting innovation, and enabling the commercial sector to enhance

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U.S. national security space capabilities. Doing so would also reduce the unintended incentive that export controls have provided to other countries to develop their own technologies, which has helped proliferate the very capabilities export controls hoped to restrain.

2. **Modernize and streamline the licensing process.** The existing interagency licensing process for activities covered by current authorities is far too slow, inefficient, and uncertain. It is not uncommon for companies to spend many months waiting on their license, with no clear end date, and for licenses to be denied for unnamed reasons the company cannot easily discover. Civil agencies, such as those in the Department of Commerce or Department of Transportation, should have clear authority to approve and issue licenses without burdensome interagency debates or undue interference from the national security community, and there should be a rigorous and transparent appeals process for licenses that are denied. Licensing requirements, such as ground station visits, that are outdated and no longer applicable for current technology should be reduced or eliminated. Finally, there should be a presumption of approval of licenses for space activities that are not first-of-kind. Together, these changes would reinforce the competitive advantage the United States holds as new commercial space companies choose jurisdictions in which to establish operations.

3. **Provide more certainty to private sector innovators.** There are several types of commercial space activities planned for the near future that do not clearly fall under any of the existing licensing authorities. These gaps create uncertainty that gives rise to real-world challenges for start-up companies trying to secure investors and insurers, a phenomenon many new space companies are struggling with. Providing a clear legal pathway for all commercial space companies, including those with new and innovative ideas, to secure a license would send a strong positive signal to markets and encourage more entrepreneurship.

4. **Enhance the data and services available to make responsible decisions on orbit.** Improving space situational awareness (SSA) data and services for all space actors, governmental and commercial, is essential to ensuring the long-term sustainability of space. Historically, the U.S. government, and in particular the U.S. military, has been the primary global provider of these data and services. However, the vast increase in the number of satellites, with at least 18,000 currently planned to be launched in the next decade, threatens to overwhelm the military's current SSA capabilities, and distract from its core national security mission. At the same time, private sector SSA capabilities are rapidly improving, with multiple entities now offering access to data and services that will likely equal, or surpass, those of the government in the near future. While we believe that these private sector SSA capabilities should be leveraged to the utmost, we still believe that there are aspects of SSA that are inherently governmental responsibilities. The Department of Transportation should be empowered to work with the private sector,

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academia, and the international community to develop public SSA data and services that enhance the safety and efficiency of space activities for all.

5. **Continue U.S. engagement in international discussions on best practices and transparency and confidence building measures.** The global nature of space cannot be ignored. More than sixty countries are currently engaged in space activities, and many are putting in place national frameworks to enable their own commercial space sectors. Over the last decade, there have been significant international discussions on a variety of sustainability, safety, and security topics both within the United Nations system and outside of it. The value of these discussions has been that many more countries are now aware of, and engaged on, space sustainability and security issues than ever before. Withdrawing from these discussions will only ensure they continue without U.S. participation and create opportunities for other nations to use such discussions to advance their own interests. Continued U.S. participation, and constructive engagement, will help ensure that the United States maintains its historical leadership role and can continue to shape the outcomes to fit its national interests.

SWF pledges to do its part to help achieve these goals through our own complementary activities. In 2016, we were a founding member of the Hague Space Resources Working Group that brings together governments, academia, and the private sector to discuss best practices and oversight frameworks for enabling commercial space resource utilization. In February 2017, we released our *Handbook for New Actors in Space*, which provides an overview of the international framework, national law and policy, and space operations best practices for both governments and commercial operators. And throughout 2017, we plan to hold a series of workshops to facilitate discussions among commercial space operators about best practices and norms for cubesats, large constellations, and rendezvous and proximity operations in orbit that the private sector can develop on its own independent from governments.

In conclusion, SWF would like to once again commend the subcommittee for focusing on such an important issue, and express our support for helping to develop an oversight framework that can help bring about sustainable commercial innovation in space that will provide new and enhanced space capabilities to address the challenges we face on Earth.

Respectfully,

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