A Framework For The Effective Implementation Of Commercial Space Stations

Policy Considerations and Recommendations

This paper is a product of the Commercial Space Station Working Group of the Beyond Earth Institute Leadership Council. While the paper represents a consensus of Working Group discussions, the views and recommendations do not necessarily represent those of the members or their respective organizations.

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I Executive Summary

In just six decades, space travel has evolved from a mere theory to a nearly $500 billion industry.[1] In the face of broader economic concerns, the space industry has steadily expanded reinforcing its prominence as a driving force of the global economy. From Global Positioning Systems (GPS) to long distance communication to remote sensing that allows scientists to monitor, predict, and combat climate change, the world as we know it would not exist without space technology.

The space sector is now moving into a new era of activity and the current global and domestic framework does not sufficiently support the private space sector that has been driving the industry's growth.

This need for a new legal and regulatory regime is made even more imperative by the United States (US) Government's plan to decommission the International Space Station (ISS) by 2030 or soon thereafter.

The void created by decommissioning the ISS, for both government and private users, is one that must be filled. A new government-owned and operated space station is neither feasible nor desirable. The National Aeronautics and Space Administration's (NASA) Commercial Low Earth Orbit (LEO) Destination (CLD) program seeks to foster the development and implementation of privately owned and operated space stations.

1 "The Space Report 2022 Q2," Space Foundation, July 27, 2022, https://www.spacefoundation.org/2022/07/27/the-space-report-2022-q2/.

This effort to fully integrate the private space sector into the LEO economy is evidence of the shared desire for commercialization. One that is both ripe with great potential and fraught with uncertainty.

While there is a need for government engagement to help establish new rules of the road, this role is one that must evolve carefully and be informed by experience. Rather than taking the lead on the development of the space industry from the ground up, the modern governmental role must be one that stimulates, supports, and benefits the private space sector. As such, the space industry is presently at a crossroads—while there government support for the continued commercialization of outer space is evident, the regulatory scheme that will govern in-space activities runs the risk of potentially hindering its desired growth.

At the core of this issue are two fundamental challenges that hinder the progress of commercial space stations. First, the private space sector is beholden to a myriad of government regulators. In order for CLDs to fill the void left by the decommissioning of the ISS, and begin a new chapter of human presence in space, there should be a single regulating body to streamline the regulation of in-space activity. Second, there is a notable lack of commercial insurance market capacity and financially feasible protection options for financial loss or calamity for space activities. Finally, there is a need for a reworking of the indemnification scheme as it applies to commercial space stations and the service providers they utilize to operate on their stations.

With the advent of commercial space stations, we are at a unique moment in time where the domestic regulatory framework that has governed space activities must be revisited to support the shared interest of the US government and private sector. Addressing these issues at the domestic level is one piece of the puzzle, as space activity is governed by both national and international legal regimes. From the international perspective, there is an apparent need for a single regulatory scheme for domestic space policy to fulfill the obligations of the Outer Space Treaty. Furthermore, while international law does place constraints on domestic space policy, there is potential for the development of international norms via domestic action. What is evident through an examination of the challenges and potential solutions facing the private space sector as they embark upon the heady task of developing, launching, and operating commercial space stations and payloads is that there is a responsibility that the government aids in streamlining this process.

II Background

The early era of space exploration was wholly government funded, initiated at first in response to Cold War competition. As the fabric of space activities have evolved and expanded over the last half-century, a government owned-and-operated space industry is neither feasible nor practicable. As Vice President Kamala Harris stated as Chair of the National Space Council, "our nation is entering a new era."[2]

Commercial LEO Destinations

The ISS has been and continues to be an unmatched feat of science, technology and international cooperation. Beginning in 1998, the 356-foot structure required 42 launches to complete in-orbit construction of a multi-module space station. The significance of this project truly cannot be overstated as it evolved into an invaluable proving ground for a vast body of scientific research and commercial innovation. The ISS is an intergovernmental project that is owned and operated by five space agencies and fifteen countries. In 2023, the preeminence of a fully government-run space program is no longer feasible. Space innovation is a costly game that requires private sector capital and resources.

Transitioning Away From the ISS

In preparation for the decommissioning of the ISS, NASA is currently supporting four commercial ventures developing potential successors to ISS. In February 2020, NASA contracted with Axiom space to develop an orbital segment to initially be attached to the ISS and ultimately operate as part of a fully commercial space station.[3] The following year, NASA additionally entered into agreements with Blue Origin, Nanoracks LLC, and Northrop Grumman to build independent space stations.[4] Then, in January 2022, NASA issued the International Space Station Transition Report (Transition Report), outlining the plan to support commercial growth in LEO via CLDs by 2030. In this report, NASA committed to working in tandem with private companies to aid in the development of CLDs with the goal of fully transitioning to commercially-operated space stations.[5] There will be some consolidation, naturally. Northrop Grumman has already reneged and will now support Voyager Space.

For NASA and other government agencies, the benefit of the commercial space economy cannot be overstated. As the Transition Report discusses, "[i]t is in the interests of the United States that a seamless transition be made

2 Vice President Kamala Harris, "Remarks by Vice President Harris on Supporting the Commercial Space Sector" (Speech, Oakland, CA, August 12, 2022), The White House, https://www.whitehouse.gov/briefing-room/speeches -remarks/2022/08/12/remarks-by-vice-president-harris-on-supportingthecommercialspacesector/#:~:text=And%20 to%20seize%20that%20opportunity,space%20for%20millions%20of%20Americans.

3 "NASA Selects First Commercial Destination Module for International Space Station," NASA, January 27, 2020, https://www.nasa.gov/press-release/nasa-selects-first-commercial-destination-module-for-international-space-station; "Axiom Station", Axiom Space, accessed September 20, 2023, https://www.axiomspace.com/axiom-station.

4 "NASA's Commercial Partners Pass Milestones for New Space Stations," NASA, July 26, 2023, https://www.nasa.gov/feature/nasa-s-commercial-partners-pass-milestones-for-new-space-stations/.

5 NASA, International Space Station Transition Report (January 2022), 3.

from ISS to one or more future CLDs such that no gap in the Government's ability to use low Earth orbit space platforms is experienced."[6] Further, government-funded efforts alone cannot support the type of growth and development necessary to maintain a leading role in the emerging space econosphere. Through the public-private partnership model, government agencies are able to impart the wisdom of decades of development onto private companies that are willing and able to advance the space industry at a much faster rate. The public-private partnership model operates on a symbiotic relationship between both parties that allows the entities to share decision-making power.

In addition to the NASA CLD program, other private companies have entered the commercial space station forum. For example in November 2022, Gravitics announced $20 million in seed funding to design StarMax, a large-form space station module that boasts a usable internal volume of almost half the ISS, making it a desirable base unit for many configurations of commercial space stations.[7] Unlike many other companys' approach to space activities, Gravitics has not entered the market as a space station operator but rather as a module supplier. Six months later Vast announced plans for Haven-1, a single module space station that would utilize the SpaceX-operated Dragon spacecraft to hopefully launch by 2025.[8]

This ambitious launch schedule would potentially make Vast the first fully commercial space station in LEO. Both the Gravitics and Vast projects also call to attention the very unique relationships that the private sector has fostered within itself in addition to those amongst government agencies.

With the private sector entering the domain of habitable space stations and other novel space activities, there is a need for a regulatory scheme that supports the growth that the government recognizes as a pressing need. By her own admission, Vice President Harris acknowledges that "we have got to update the rules, because they're just simply outdated. They were written for a space industry of the last century."[9] Despite the trend in legislation in support of commercialized space, lingering questions remain concerning the future of commercial space facilities, products and services.

The commercialization of outer space activities has continued to vex the existing systems of international law because Treaties like the 1967 Outer Space Treaty[10] and the 1972 Liability Convention bind States party to the treaties rather than private actors. As the foundation of international law is the governance of relations between States, there is an inherent challenge in conceptualizing the regulation of a fully commercial space venture.

Level Setting—The Artemis Accords

The Artemis Program and Accords are yet another example of level-setting through international means other than treaty law.[11] In light of the growing chasm between existing international space law and the actual realities of space activity, the US developed the Artemis Accords as an attempt to push space law forward. The Artemis Accords are a set of non-binding "political commitment[s]" initially agreed upon by nine signatories committed to the production of future bilateral agreements.[12] The passage of the 2015 Commercial Space Launch Competitiveness Act (SPACE Act) expressly authorized US citizens to "engage in commercial exploration for and commercial recovery of space resources free from harmful interference."[13]

The Artemis program outlines two major goals: to first send humans back to the Moon, and then to Mars. To achieve these goals, the program emphasizes the role private companies must play in the future of space exploration. The Artemis Accords are a contemporary example of the ways in which commercial interests have been incorporated into international legal principles. Signed by twenty-eight nations across six continents, the sweeping acceptance of the Artemis Accords evinces a global interest in supporting the future of commercialized space activities.

The US space industry–both public and private–has a unique opportunity at a unique point in time to enact domestic policy that has the power to shape the future of international law as well. Establishing a business-friendly regulatory environment not only aids US-based companies in the development of new technologies but also makes the US market more favorable to other nations interested in strategic partnerships.

6 Ibid., 5.
7 Alan Boyle, "Gravitics raises $20M for plans to build space station modules north of Seattle," Geekwire, November 17, 2022, https://www.geekwire.com/2022/gravitics-raises-20m-for-plans-to-build-space-station-modules- north-of-seattle/; "Starmax," Grativics, accessed September 20, 2023, https://www.gravitics.com/starmax.
8 "VAST Announces the Haven-1 and VAST-1 Missions," Vast Space, May 10, 2023, https://www.vastspace.com/ updates/vast-announces-the-haven-1-and-vast-1-human-spaceflight-mission-launched-by-spacex-on-a-dragon-spacecraft.
9 Vice President Kamala Harris, "Remarks by Vice President Harris on Supporting the Commercial Space Sector."
10 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Preamble, Jan. 27, 1967, 18 UST. 2410, 610 U.N.T.S. 205 (entered into force Oct. 10, 1967), *hereinafter* Outer Space Treaty; Convention on the International Liability for Damage Caused by Space Objects, 961 U.N.T.S. 187 (entered into force Mar. 29, 1972), *hereinafter* Liability Convention.
11 "NASA Artemis,"*NASA*, accessed October 10, 2023, https://www.nasa.gov/specials/artemis/.
12 *The Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids*, NASA (Oct. 13, 2020).
13 US Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90.

III The Regulatory Issue

The commercial habitats are, at present, in a nascent state of development with some of the earliest proposed launches set for 2025. With that in mind, there has been a constant critique from the private sector that these projects have been and continue to be tied up in an "alphabet soup" of regulatory uncertainty. From questions about what agency issues licenses to what agency may claim to have a stake in space activities, the unanswered questions surrounding the regulatory framework for commercial space stations is an ongoing concern.

It is important to note that the scope of the forthcoming discussion regarding the regulatory issues surrounding commercial space stations is limited to in-space activity, which here means activities taking place in orbit including products produced in space and returned to Earth. This specifically excludes launch and reentry operations already under the purview of the Federal Aviation Administration (FAA), regulation of transmissions under the Federal Communications Commission (FCC), and Earth remote sensing under the National Oceanic and Atmospheric Administration (NOAA).

When examining the roadblocks, detours and uncertainties created by the present lack of regulatory clarity, there are in essence two main aspects that must be addressed: a) how regulation may occur and b) when regulation may apply to a specific commercial space station project.

The How

Despite asking the pertinent questions about the regulation of commercial space stations, regulatory decisions have not yet been made. While this lack of clarity breeds uncertainty, it also presents an opportunity for the private sector to be at the forefront of the development of the requisite regulatory framework.

***Recommendation*:**
Organize the regulatory regime governing commercial space stations under a single regulator

As the growth and success of the commercial space industry is a defined goal of the US government, potentially the most effective path toward achieving the symbiotic goals of the public and private sector is the implementation of a single regulator for CLD activities. The need for a "one-stop shop" for commercial space activities, including investment opportunities originating both domestically and abroad, has never been more important than it is now.

If the ambiguities in commercial space regulations are left unaddressed, it opens the door for potential jurisdictional grabs by a myriad of agencies that may not, at first glance, be related to outer space at all. As space activities expand, so too will the interest of a variety of federal agencies. For example, any pharmaceuticals created or tested on a commercial space station likely will spark the interest of the Food and Drug Administration (FDA). Similarly, the Occupational Health and Safety Administration (OSHA) may develop an interest in working conditions onboard a space module. With each agency's interest comes the possibility for another unique and time-consuming—and potentially conflicting—set of regulatory hoops that the private sector must grapple with. And while Congress has not yet authorized these agencies to have oversight over space activities, developing a prophylactic regulatory framework is the key to avoiding a system so prohibitive that it dampens commercial investment and innovation.

***Recommendation*:**
The Department of Commerce is a logical choice for a single regulator regime

The discussions surrounding the regulation of commercial space stations and other novel space activities have historically trended toward organization under either the Department of Commerce or the FAA. The Department of Commerce, which already houses the Office of Space Commerce (OSC), is potentially the most logical choice for a single regulator regime. At present, the Department of Commerce is already a central regulatory body for the commercial space industry at large. Through the OSC, the Department coordinates space activities conducted by supporting agencies including NOAA, the National Telecommunications and Information Administration (NTIA), and the National Institute of Standards (NIST). In a March 2023 address, Deputy Secretary of Commerce Don Graves addressed the five focus areas of the Department's strategic plan on space commerce, which included "coordinating regulatory functions."[15] The Department of Commerce is particularly effective in carrying out the regulatory responsibilities of commercial space activities because "our work…is designed to promote competitiveness and increase legal certainty, transparency, and consistency for commercial space businesses."[16]

Moreover, the Department of Commerce has already been foundational in the clarification of export control roadblocks to the private sector. While export controls are essential restrictions on the sharing of some types of technologies that may pose national security risks, these controls significantly impede the flow of commerce. Thanks to a Department of Commerce-led push, a small but significant policy change to the Missile Technology Control Regime (MTCR), led to a policy change that

14 Space Policy Directive-2 of May 24, 2018, 83 Fed. Reg. 104.
15 Deputy Secretary of Commerce Don Graves, "Remarks by Deputy Secretary of Commerce Don Graves at the Satellite 2023 Government and Military Forum" (Speech, Washington, DC, March 15, 2023), US Department of Commerce, https://www.commerce.gov/news/speeches/2023/03/remarks-deputy-secretary-commerce-don-graves-satellite-2023-government-and.
16 Ibid.

determines exports of "satellite-related tech and know-how" on a "case-by-case basis."[17]

Moreover, under Article VI of the Outer Space Treaty, legal obligation is owed by a state because of the duty to "authorize and continuously supervise" space actors. Absent a clearly defined regulatory framework, there remains a question as to whether commercial space stations are continuously supervised within the purview of Article VI. This further emphasizes the need for a single regulator that would assume the authorization and continuous supervision responsibilities imposed by Article VI.[18]

The establishment of a regulatory scheme operated by a single regulator like the Department of Commerce is the most effective method to carry out the international obligations set forth by the Outer Space Treaty. With its history as a regulatory body for space activities, the Department of Commerce is a strong candidate for the task of both authorizing and also supervising commercial activity in outer space. From the perspective of supporting private sector growth, the Department of Commerce appears to be the most rational choice. At its core, the Department of Commerce's goals most closely align with commercial interests and support shared public-private goals.

Recommendation: Consider the US State Department's Circular 175 process as a model for a single regulator regime for determining commercial space regulations

The US State Department's Circular 175 (C-175) process describes the operation through which the Executive Branch determines whether or not to enter into international agreements. The purpose of the C-175 process is to "facilitate... the application, of orderly and uniform measures to the negotiation, conclusion, reporting, publication, and registration of US treaties and international agreements..."[19] This is a process whereby proposed international agreements are circulated to all federal agencies so they have a chance to identify potential impacts and have their concerns heard in a single coordinating forum.

The key element of the C-175 process is that it serves a "centralizing role." In the context of the regime for commercial space stations, the C-175 process serves as an effective model to be enacted by the Department of Commerce for coordinating inputs from various agencies using a holistic approach. While it may not be effective to allow every agency to have a direct slice of the regulatory pie, that does not mean that these agency's considerations be excluded entirely. A centralized interagency review process would both streamline regulation and also provide an avenue for individualized concerns to be analyzed.

Ultimately, the discussion surrounding how the regulatory framework ought to evolve to support the development of commercial space stations relies on the understanding that the private sector cannot be bogged down by either uncertainty or an endless barrage of regulatory hoops. In this regard, the looming lack of direction by the Administration and Congress presents just as much of a challenge as the promulgation of restrictive regulation because it disincentivizes investment in the unknown. Thus, potentially the most effective way to fully realize the shared goals of both government and private actors is to implement a single regulator system that emphasizes defined and streamlined regulation.

The When

An equally important question when assessing the efficacy of a regulatory regime is when regulation applies. Given the youth of commercial space station development, it would be ineffective to enact a regulatory system that attempts to account for every possible scenario, system design and operational construct at this stage.

Recommendation: Establish a milestone-based system of commercial space station regulation and payload operations

Regulatory frameworks exist to protect stakeholders from the dangers of a world without standards and best practices. However, space is a unique and inherently hazardous environment that cannot be assessed using terrestrial standards. The governmental role in regulating CLDs and their accommodated payloads is one that must occur in broad strokes to prioritize safety and minimize the potential for risk. It must also be recognized that there is no feasible way to fully regulate away the dangers of space exploration. Furthermore, there is no dispute that government regulation of space activities is necessary. Rather, there is a need for regulation that actually achieves its goals. It is essential that the regulation of commercial space habitable stations, facilities, and payloads evolve with the development and operation of CLDs rather than attempt to anticipate these needs without experience. Thus, a milestone-based system will likely prove the most effective avenue.

17 Theresa Hitchens, "Commerce eases satellite exports to MTCR partners; South Korea a key focus," *Breaking Defense*, March 16, 2023, https://breakingdefense.com/2023/03/ commerce-eases-satellite-exports-to-mtcr-partners-south-korea-a-key-focus/.
18 Outer Space Treaty, art. VI.
19 11 US Dep't of State, Foreign Affairs Manual §§ 721-727.

IV The Indemnification Issue

In addition to the urgent need for regulatory streamlining, indemnification of commercial space actors remains a serious and largely unanswered question.

Lack of Commercially Available Insurance

Insuring space activities is expensive due to the unquantifiable risks inherent in the ultrahazardous nature of conducting extraterrestrial business. Each satellite launch increases the risk of detrimental collisions that would result in even more space debris. From the dangers of space launch and reentry to on-board hazards, it is very difficult for the private sector to access commercially available insurance at a reasonable price. The present insurance market is already at capacity. With the influx of new launchers as LEO continues to commercialize, there are simply not enough insurers. As the field expands, so too does the glaring need for commercially available insurance.

In comparison to premiums for commercial aviation activities, insurers that underwrite space premiums often charge 10-20 times the cost.[20] While some insurers have provided third-party liability insurance to the private sector for unmanned space activities, many are hesitant to extend this coverage to manned operations.[21] Further, should a devastating collision occur in LEO, the now-expensive insurance would likely be all but impossible for most companies to afford.

In addition to having a vested interest in the success of commercial space stations, NASA has decades of experience with both successful and unsuccessful human-tended space launches. The ability to utilize NASA as an educator to aid the private sector, and in particular the insurance industry, in understanding the risk factors of private astronaut missions is essential to the success of these ventures.

***Recommendation*:**
The government should provide third-party indemnification coverage

Liability for space activities is inextricably linked to the State under international law. The Outer Space Treaty mandates that states party to the treaty "bear international responsibility for national activities"[22] and are "internationally liable for damage."[23] The subsequent Liability Convention assigns liability to the "launching state."[24] This reinforces the need for direct government involvement in indemnification of commercial space activities.

The innovations in space technology that have allowed the United States to remain an industry leader are largely thanks to the increased role of the private sector. In order for this innovation to continue, space needs to be financially accessible. Thus, there is a governmental obligation to work in tandem with the commercial space industry to develop a reasonable structure that allows the private sector to obtain the insurance necessary to engage in space activities like commercial space stations.

Conclusion V

Commercial space stations are an essential next step for the commercial space sector. The success of commercial space stations depends on a whole of government approach to regulation and indemnification. As we near the end of 2023, the need to develop a reasonable and effective regulatory structure in the proper time frame so as to not dampen a budding industry has never been more important. The only way that entering into the LEO commercial economy is a feasible business venture is with government support. Thus, potentially the most foundational aspect of the discussion surrounding the future of CLDs is the government obligation to work with the private sector to develop a reasonable and effective regulatory structure and do its part to foster a commercially viable business environment by supporting insurance with expertise and indemnification.

Summary of Recommendations

In the face of lack of direction by the Administration and Congress, the pressing concerns that pose challenges for the future of commercial habitats in outer space are regulatory roadblocks, the lack of commercially available insurance. Given these concerns, this paper posits five main recommendations. First, that the regulatory regime governing on-orbit activities be centralized under a single regulating body. Second, that the Department of Commerce is uniquely adept and fulfilling the role of coordinating regulator. Third, that the regulatory process would benefit from utilizing the US State Department's Circular 175 process as a model and fourth, that the regulatory regime ought to utilize a milestone-based methodology of enforcement. Finally, given the difficulties of obtaining insurance for space activities, the US government should support the insurance industry with expertise and provide third-party indemnification coverage to the private sector.

20 Noor Zainab Hussain and Carolyn Cohn, "Launching into space? Not so fast. Insurers balk at new coverage," *Reuters*, September 1, 2021, https://www.reuters.com/lifestyle /science/launching-into-space-not-so-fast-insurers-balk-new-coverage-2021-09-01.
21 "Space Insurance Industry Outlook: Price & Coverage for Satellites & Space Flight," Beinsure, June 22, 2023, https://beinsure.com/space-insurance-industry-outlook-price-coverage/.
22 Outer Space Treaty, art. VI.
23 Ibid., art. VII.
24 Liability Convention, art. I.

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