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Policy Challenges Of Commercial Space Stations

The First Rung Toward Space Habitation

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I Introduction

Orbiting just 250 miles above the Earth, the International Space Station ("ISS") has operated as a collaborative project between five space agencies: NASA, Roscosmos, JAXA, ESA, and CSA.[1] Since its launch in 1998, the ISS has provided the international community with a platform for invaluable research. The ISS was and remains an incredible feat, both from a collaborative and technical perspective. The project, which called upon the cooperation of 15 countries, required 42 launches to assemble the 356-foot structure.[2]

While the contribution of the ISS to science, research, and as a testbed for further space exploration is settled, it is also undeniable that a new era of commercial space exploration is upon us. Congress has extended NASA's commitment to supporting the ISS through 2030. This seems to be in concert with NASA's stated goal of transitioning away from a government-run space station model, but it is not entirely clear if this is Congress' intent.

The push to commercialize outer space is by no means a novel concept. The space industry that was once tightly controlled and funded by national governments has expanded into a multi-billion-dollar market-driven industry (it may be worth noting that, at this point, the market is still largely government-driven). With clearly established commercial crew and cargo transportation to Low Earth Orbit ("LEO"), NASA is looking to the private sector to take the lead in establishing commercial space habitats in earth orbit in public-private partnerships - the precise terms of which are TBD.

[1] International Space Station Intergovernmental Agreement, 80 Stat. 271, T.I.A.S. 12927, entered into force Jan. 29, 1998
[2] https://www.nasa.gov/feature/facts-and-figures

II Background: The Advent of Commercial LEO Destinations

Space activities are technologically demanding, cost-intensive, and often cost-prohibitive. In the early years of space exploration, the industry was controlled and funded mainly by governments. However, the significant infusion of private capital in the space industry has opened the door for rapid innovation. In particular, NASA's Commercial LEO Development (CLD) Program seeks to foster the establishment of privately owned and operated space stations, or "destinations," that are freely available for use. These CLDs demonstrate the transition toward a commercial space economy in which NASA and other national space agencies act as customers rather than owners and operators.

Commercial LEO Destinations

In January 2022, NASA published the International Space Station Transition Report ("Transition Report"), which outlined a plan to transition LEO activities away from the ISS and onto CLDs by 2030.[1] This shift is to take a two-phase approach in which commercial actors first work in tandem with NASA to design CLDs with the ultimate goal of transitioning to commercially-operated space habitation.

Two major steps have already been taken to realize the first phase of this transition. In February 2020, NASA contracted with Axiom Space "to provide at least one habitable commercial module to be attached to the [ISS]."[2] Then, in December 2021, NASA announced that it had signed agreements with three companies–Blue Origin, Nanoracks LLC, and Northrop Grumman Systems–to design "free-flyers."[3] Unlike the Axiom contract, these space stations are intended to bypass the ISS entirely, going directly into orbit.

NASA has awarded over $555 million for CLD contracts to establish a functioning LEO space environment when the ISS is decommissioned.[4] The public-private partnership model allows NASA to provide decades of research and experience to private companies and creates a symbiotic relationship between both parties. Alongside this initiative, Axiom is working on and seeking to implement cutting-edge technologies through investor, and revenue-driven, capital.

For the private sector, the benefit of CLDs goes far beyond the contractual relationship with NASA. In implementing a public-private partnership model, government and private entities share the decision-making power. The companies that develop these space stations ultimately own their intellectual property and have the potential to expand far beyond the government market.

III Challenges to Commercial Space Stations

At present, a fully commercial space station is uncharted territory that brings with it a slew of hurdles that must be overcome in order to fully realize its potential. The policy challenges that a fully commercial space station may face are numerous; however, they can be loosely divided into three categories: environmental, regulatory, and international.

Environmental Challenges

LEO offers immense commercial opportunities; however it is not without significant risk. As LEO increasingly becomes the subject of commercial ventures, the area risks dangerous overcrowding. Space debris—"[e]ven tiny paint flecks"—remains a serious issue that threatens to turn LEO into a "heavenly junkyard."[5] The Kessler Syndrome describes the genuine possibility of debris collision resulting in a cycle of continuous fragmentation and, ultimately a "self-sustaining cascading collision of space debris" that would make LEO unusable.[6] While space debris is by no means a challenge faced exclusively by CLDs, it is nonetheless a serious concern as the LEO environment rapidly populates.

The problem with space debris is that it requires two avenues of mitigation: elimination and prevention. While attempting to move the international community forward, the Space Debris Mitigation Guidelines are merely an assembly resolution and are entirely at the discretion of states to implement.[7] The growing and largely unmitigated presence of space debris adds to the long list of potential hazards for space stations. Additionally, should an accident occur, it would exacerbate the space debris situation dramatically.

Regulatory Challenges

The establishment of CLDs presents domestic regulatory challenges. Space activities are regulated by various agencies including NASA, Federal Aviation Administration ("FAA"), the Federal Communications Commission, and the National Oceanic and Atmospheric Administration.

Export Controls - In the United States, export controls are government-sanctioned restrictions on sharing certain technologies with foreign actors. While export controls evince an interest in preserving national security, it has historically limited the flow of commerce. The International Traffic in Arms Regulations ("ITAR") operates under the jurisdiction of the Department of State and is administered by the Directorate of Defense Trade Controls.[8] ITAR authorizes restrictions on the "export and import of defense articles and defense services" to ITAR-prohibited countries.[9] The National Defense Authorization Act for Fiscal Year 2013 initiated overdue yet limited, export control reform, authorizing the removal of satellites and other space-related items from the United States Munitions List ("USML").[10] Now, dual-use items, including those found on the ISS, are governed by the Export Administration Regulations ("EAR").[11]

ITAR has been routinely criticized for hindering the ability of American companies to engage in the global market, leading to significant efforts in the last decade to relax export controls relating to commercial satellites. The USML maintains a list of ITAR-covered articles and services and makes certain "carve-outs" for some space-related activities.[12] Specifically, Category XV details that exports intended for use on the ISS are subject to EAR jurisdiction.

1 https://www.nasa.gov/sites/default/files/atoms/files/2022_iss_transition_report-final_tagged.pdf, 3.
2 https://www.nasa.gov/press-release/nasa-selects-first-commercial-destination-module-for-international-space-station
3 https://www.nasa.gov/sites/default/files/atoms/files/2022_iss_transition_report-final_tagged.pdf, 3.
4 Axiom Space ($140 million); Blue Origin ($130 million); Nanoracks LLC ($160 million); Northrop Grumman ($125.6 million).
5 Humaid Alshamsi et. al., As the Grapefruit Turns Sixty, It's Time to Get Serious About Clean Up in Outer Space (2018), 48.
6 Id. at 51.
7 Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space (2007).
8 22 C.F.R. § 120-130.
9 Id. at § 120.1.
10 Pub. L. No. 112-239 § 1261(a)(1) ("Section 1513 of the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999...is amended by striking subsection (a)").
11 15 C.F.R. § 730 et. seq.
12 22 C.F.R. § 121.

International Challenges

Commercial space stations present a unique challenge to the structure of international law, which governs relations between countries. As such, treaties like the 1967 Outer Space Treaty[1] and the 1972 Liability Convention[2] bind States party to the treaties rather than private actors.

Liability - Liability in outer space is grounded in international law. Article VI and VII of the Outer Space Treaty mandate that states party to the treaty "bear international responsibility for national activities"[3] and are "internationally liable for damage."[4] It is clear that the international legal framework has not contemplated a commercialized outer space. Following on the heels of the Outer Space Treaty, the Liability Convention assigns liability to the "launching state." On the one hand, the concept of the "launching state" poses some serious problems when considering the complexities of modern commercial enterprises as the term may apply to 1) the State that launches; 2) the State that procures; 3) the State whose territory a space object is launched from; or 4) the State "from whose…facility a space object is launched."[5]

Moreover, under international law, the legal obligation is owed by a state because of the obligation to "authorize and continuously supervise" space actors.[6] Absent a clearly defined regulatory framework, there remains a question as to whether CLDs are continuously supervised within the purview of Article VI of the outer space treaty. At present, there is a regulatory gap for on-orbit commercial activities that needs to be filled.

End of the ISS Barter System - The 1998 ISS Intergovernmental Agreement ("IGA") established the terms and framework for the partnership between the partner countries.[7] A critical aspect of the ISS IGA was the right of any Partner to "barter or sell any portion of their respective allocations."[8] In practice, this provision allowed the Partners to provide goods and services without financial compensation, which benefited nations with lesser space-faring capabilities. Outside the cooperative realm of the ISS, many nations and space agencies may be limited in their ability to engage with foreign markets. For example, the ESA's 2025 Agenda explicitly outlines an interest in supporting European space companies.[9] Therefore, the end of the barter system not only runs the risk of limiting access to outer space but also may lead to strained relations between the former partners of the ISS.

IV Solutions/Policy Recommendations

With a timeline that anticipates a transition toward commercial space stations in under a decade, the challenges the CLD project faces are numerous. Despite this, it is essential to remember that this transition doesn't eradicate the existing frameworks, as noted below, that have allowed the private space sector to flourish for decades. Ultimately, both public and private players have a vested interest in the success of CLDs.

Utilizing the Public-Private Partnership

As with any public-private partnership, both parties have invested time, money, and resources into the project's success. In the Transition Report, NASA states its "intention to ensure continued collaboration with Partners on a U.S. CLD through government-to-government, government-to-industry, or industry-to-industry arrangements."[10] NASA may act as a broker between commercially owned and operated CLDs and foreign entities in situations where parties cannot or will not do business with the private sector. In certain situations, this model may bridge the gap in the transitional period between the ISS and a largely commercialized LEO.

Whole-of-Government Approach to Regulation

The success of commercial space stations will require a whole of government (WoG) approach rather than the discrete implementation of regulations across a vast array of federal agencies. Recent efforts to streamline the private space sector suggest a willingness to adopt a WoG approach to continue to foster commercial growth. For example, consolidating commercial launch and reentry requirements into Part 450 "increase[d] flexibility for launch and reentry vehicle operators" by mandating only a single license for all commercial launch and reentry activities.[11]

A fully commercial space station will necessarily require a regulatory framework that spans agencies to ensure compliance at a domestic and international level.

Drawing on Existing Models of Private Sector International Cooperation

The success of the ISS IGA makes manifest the need for a cooperative international framework moving forward. While there are clear benefits to working within the traditional governmental structure, it would be wholly inaccurate to assert that the private space sector has been operating absent any sort of global cooperation thus far. In fact, the private sector has long been filling in the gaps where government actors could not or would not act.

Many space-related companies have resorted to cooperative data sharing due to a lack of reliable space situational awareness ("SSA") data sharing at the national level. The Space Data Association ("SDA"), a nonprofit focused on providing SSA data globally, was formed in 2009 by three satellite companies: Inmarsat, Intelsat, and SES.[12] The goal of the organization is to improve the safety of space operations by increasing participation in a single data sharing network and also serves a normative function to help all satellite operators "[a]dopt best practices across [the] industry."[13]

In addition to playing a key role in the ever-present challenge that space debris and related liability pose for any space venture, the SDA structure provides a framework for the private sector to act as an independent broker. The space sector is rife with fruitful competition between space companies, yet it also means that there is an abundance of shared goals and interests. Members of the private space sector are stakeholders in the space economy. Their desire to keep their products and investment interests safe is the utmost priority. At its core, the immense success of the ISS has established a baseline proof of concept for the feasibility of commercial space stations.

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1 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 U.S.T. 2410, 610 U.N.T.S. 205 (entered into force Oct. 10, 1967)
2 Convention on the International Liability for Damage Caused by Space Objects, 961 U.N.T.S. 187, entered into force Mar. 29, 1972.
3 OST, art. VI.
4 OST, art. VII.
5 Liability Convention, art. I.
6 OST, art. VI.
7 International Space Station Intergovernmental Agreement, 80 Stat. 271, T.I.A.S. 12927, entered into force Jan. 29, 1998.
8 Id. at art. 9.
9 https://esamultimedia.esa.int/docs/ESA_Agenda_2025_final_EN_executive_summary.pdf.
10 Transition Report, 21.
11 Fact Sheet – Streamlined Launch and Reentry Licensing Requirements (SLR2) Rule, FAA (October 15, 2020), https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=25400.
12 Home, SPACE DATA ASSOC., https://www.space-data.org/sda/ (last accessed Sept. 4, 2022).
13 Jean-Luc Froelinger, An Overview of the Space Data Association and its Services, available at https://swfound.org/media/206314/froeliger_keynote.pdf.