



Insight

The Options for the Future of the International Space Station

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Executive Summary

- The International Space Station (ISS) was originally intended to last until 2015, just after the Space Shuttle program stopped, yet congressional acts have extended its lifespan, even as costs have risen for maintaining its viability.
- The Trump Administration has proposed privatizing the ISS by 2025, but this move has significant congressional opposition and might not be economically feasible: Best estimates indicate the total annualized revenues for private entities would be short of the projected costs by \$1 billion to \$1.8 billion.
- NASA should consider reforming how the rights to intellectual property developed on the ISS are allocated to encourage more private investment, along with reforming its relationship with the private organization currently managing the ISS.
- Reforms likely will not make a full privatization viable, however: The best long-term solution to the ISS's growing expense likely is decommission.

Introduction

The future of the International Space Station (ISS) is in limbo. Though it was only supposed to be in orbit for 15 years, the ISS is now going on 20. Funding for the ISS was set to end just after the station [reached the end of its life in 2015](#), but during the Obama Administration, Congress extended the life of the ISS until 2024.

At the moment, two major options exist for the ISS: privatization or decommission. President Trump's 2019 [budget](#) takes the first approach, aiming for a budgetary blackout by 2024. Successfully gaining private investment in the ISS would require reforming the National Lab on the ISS, and specifically the property rights regime. Allowing private entities to own the patents for innovations developed on the ISS could encourage significantly more investment than the ISS currently receives. In addition, the National Aeronautics and Space Administration (NASA) should consider reforming the management approach of the station.

Even with these reforms, however, the prospects for a successful privatization look dim. Best estimates indicate the total annualized revenues would be short of the projected costs by \$1 billion to \$1.8 billion. A better long-term option might be decommission—a nice word for burning up the station as it reenters the atmosphere over the Pacific Ocean.

The International Space Station's Ballooning Costs

When the ISS was [first conceived](#), it was intended to be a laboratory in space, a permanent observatory, and a staging base for future missions. Yet these goals did not translate into a financially stable mission. As [the Washington Post noted](#) some years ago, the ISS was built primarily to give the space shuttle somewhere to go.

Perhaps not surprisingly, the ISS has become one of NASA's most expensive projects. According to NASA's Inspector General (IG), [over \\$87 billion](#) has been put into the station so far, and NASA is projected to spend between \$3 to \$4 billion per year to maintain it. In total, the ISS maintenance comprises a fifth of NASA's \$19.1 billion budget. Further, a significant proportion of spending on the ISS comes from transportation, about 34 percent. Since NASA decommissioned the Space Shuttle back in July of 2011, NASA has been working with the Russian government for crew transport and private companies for cargo transit. The cost of transporting crew has increased sharply over the years. Before the Space Shuttle program was shut down in 2008, NASA bought tickets for [\\$21.8 million per seat](#). By 2018, however, that cost had increased to \$81 million per seat, an increase of 372% over 10 years. NASA [recently](#) released a list of 10 private companies that it will be working with to develop commercial crew transport. Still, the move toward commercial partners could come with a 59 percent increase in cost by 2024.

For most of the life of the project, NASA [planned to decommission and deorbit](#) the ISS when it reached the end of its life in 2015. In 2009 before Congress, NASA's space station manager Michael T. Suffredini [reiterated](#) that the agency was ready to prep and de-orbit the spacecraft. To accomplish this, the agency would have to work with the other countries to come to an agreement. According to the IG, the path to de-orbit would [cost](#) \$950 million and take three years.

But with a change in administration in 2009 came a change in direction. Florida senator Bill Nelson [exemplified the](#) then-current sentiment: "If we've spent a hundred billion dollars, I don't think we want to shut it down in 2015." The Obama administration's fiscal year 2011 budget requested that the station's life be extended to 2020, which was codified in the [NASA Reauthorization Act of 2010](#). In 2015, the ISS' life was again extended, this time up to 2024 by the [U.S. Commercial Space Launch Competitiveness Act](#). This bill's main goal was to increase commercial utilization of the ISS and to "ensure that the ISS remains a viable and productive facility capable of potential U.S. utilization through at least FY2024."

If certain politicians could have their way, the ISS would likely remain in operation well past 2024, yet the station is simply getting old. Though it was originally designed for just 15 years, the ISS has been operating in low earth orbit (LEO) for 20 years. Before too long, some of the critical modules will become unsafe, necessitating some change: At a technical level, the station's various parts cannot [last much past 2028](#). And these repairs and replacements will be very costly.

Still, these projected costs are likely to increase even more, according to a [report](#) by the IG. Because the eleven members of the European Space Agency have yet to [commit](#) to continued operation of the ISS beyond 2020, the United States might be on the hook for the European portion of maintenance costs. Currently, NASA supports 76.6 percent of the project costs, with Japan second at 12.8 percent, European partners at 8.3 percent, and Canada finishing up the last 2.3 percent. If the Europeans were to exit, the United States, Japan, and Canada would have to renegotiate, and it is safe to assume that the United States would pick up at least some of the slack. The international nature of the project also makes any negotiation about the future of the station difficult because all the other partners need be on board.

These ballooning costs mean that a new course for the ISS is needed, and the Trump Administration has proposed one.

A Proposal to Privatize

The Trump Administration's Budget [proposes](#) ending direct U.S. financial support for the ISS in 2025. But

instead of deorbiting the ISS, the administration has directed NASA to hand over operations to the private sector or establish some sort of public-private partnership. NASA would rely on commercial partners for its LEO research and technology demonstration requirements. A new \$150 million program would begin support for commercial partners to encourage development of capabilities that the private sector and NASA can use.

This proposal, unsurprisingly, didn't get great a reception at the Senate Space Committee. Senator Nelson [deemed](#) it "dead on arrival" in a recent hearing. Texas senator Ted Cruz has [called](#) Office of Management and Budget personnel "numbskulls" for proposing to end ISS funding by 2025. Both have a substantial number of jobs and investment tied up in their respective home states of Florida and Texas, and together they demonstrate that there is congressional support for continued federal ISS funding after 2025.

There is also uncertainty in how the other countries will deal with U.S. commercial entrants. The [decision](#) to let in commercial entrants depends on international politics and the space exploration missions of respective countries. As noted earlier, international partners [cover](#) 23 percent of the ISS's costs, and the United States does not want to have to shoulder the burden if one pulls out. If all partners decide to pull out, costs for maintaining the ISS would rise to \$5-6 billion a year absent significant improvements to transportation technology.

Such a transition will likely prove difficult to execute. There simply isn't possible private-sector revenue for a consortium of private entities to be able to sustain the cost of operating the ISS, as the Center for the Advancement of Science in Space (CASIS) shows.

The Birth of CASIS and the Possibilities of Privatization

In 2005, the Bush administration released its "Vision for Space Exploration" plan (VSE), which sought to increase spending on space exploration while keeping the overall budget relatively constant. The plan also aimed to "promote international and commercial participation in exploration to further U.S. scientific, security, and economic interests," including research aboard the ISS. As a first step, the [NASA Authorization Act of 2005](#) designated the ISS as a national lab. NASA then [developed](#) a plan to "increase the utilization of the ISS by other federal entities and the private sector" in order to help the research and commercial utilization mission laid out in VSE.

It's important to note that even though VSE and the subsequent NASA Authorization Act of 2005 designated the ISS a national lab, the space station was still intended to be decommissioned by 2017. But under the Obama Administration in 2010, the NASA Authorization Act [extended](#) the life cycle of the ISS to 2020. This extension prompted NASA to issue a cooperative agreement notice in February of 2011 to seek a management partner for the portion of the station that was designated a national laboratory back in 2005.

CASIS was set up as a non-profit organization in November 2011 to manage the lab. CASIS' original proposal described its plan to raise \$30 to \$50 million in non-NASA funds over its first year. The original agreement also [assumed](#) that CASIS' own funding efforts would ramp up over time, and by 2020 all NASA funding for CASIS could be pulled. Almost a decade later, a vast majority of CASIS' funding comes from NASA. From 2011 to 2016, NASA [contributed](#) \$75 million to CASIS while non-NASA contributions have totaled just \$1.1 million.

This shortfall was to be expected since there has historically been "little interest from private entities for ISS research unless there was a substantial infusion of government funds," according to [an audit](#) from NASA's IG. Of the experiments conducted between December 1998 and September 2010, 81 percent were funded by NASA, 10 percent by the Department of Defense, and only 9 percent were supported by commercial entities. Even by

its own estimation, NASA thought it was unlikely that any of these commercial experiments would have taken place in the absence of the agency's in-kind contributions and assistance.

The business case for doing research on the ISS is thin at best. While there is a lot of hype, experiments in true microgravity often aren't worth the cost since research in space costs at least \$250,000 and ground-based research almost always provides similar results. Still, the ISS's future success as a research platform hinges on private funding for research. In testimony before the Senate, CASIS's Director of Commercial Innovation & Sponsored Programs [Cynthia Bouthot](#) stated, "We are truly still in the early stage phase of the process of building a sustainable LEO marketplace, with the creation of demand for access to the facility, supply, and investment."

Still, research is only a portion of the total income projected for the ISS if it were to go private. According to a [study](#) by the federally funded Institute for Defense Analysis's (IDA) Science and Technology Policy Institute, the ISS could serve as a destination for private space flight participants or government astronauts. It could also be a hub for on-orbit assembly of satellites and manufacturing, specifically high-grade silicon carbide and exotic fiber optic cables, for use on Earth or in space. It's also possible to utilize the lab for media, advertising, and observation. The total [projected revenue](#) from these activities ranges from \$455 million to \$1.19 billion. Yet these projections are speculative: Predicting revenues for any industry 10 years in advance is difficult, much less for the highly nascent space industry. And it is unclear if even the high end of these revenue projections would cover the costs of maintaining and upgrading the ISS.

Reforming CASIS and Property Rights

Regardless of the fate of the ISS, NASA can undertake several reforms in the short term to increase revenue from the ISS. For one, CASIS needs to be reformed. The original cooperative agreement [didn't feature](#) specific targets or goals for CASIS. Instead, NASA's expectations were described in broad and descriptive language and didn't include any quantifiable targets. NASA also [failed](#) to provide any guidance on how CASIS is supposed to assist the development of a commercial LEO economy. Therefore, it had simply been impossible to track the progress of CASIS. Performance plans for 2016 and 2017 included more metrics and quantifiable targets. Yet even these plans lacked critical features, as they still, according to NASA's IG, [lacked](#) tools for "implementation partners, development of research pathways, matching of researchers and funding sources, recruitment of commercial users, and striking a balance between basic and applied research."

Even the metrics that have been in place have not been met fully. For 2016, the plan [included](#) five performance goals and 22 metrics with targets. The IG's [analysis](#) showed that "CASIS reported statistics for 4 of those 5 performance goals and met 9 of 22 targets." Moreover, NASA is setting surprisingly low targets in some cases. In the 2017 plan, NASA set a target of 20 new ISS National Lab users. [According](#) to the IG, however, that target is too low considering that CASIS only used 50 percent of crew hours in 2016 while it had 16 users. The crew time is supposed to increase in 2018, so setting expectations this low simply doesn't make sense.

NASA should implement several reforms in its relationship with CASIS. The IG report provides a useful direction for these reforms when it concludes, "weaknesses in performance measurement and the lack of an overall strategy have created an environment in which NASA continues to accept incremental improvement rather than more tangible attainment of agreed-upon goals." NASA should reevaluate CASIS's current plans and strategies. It also needs to take a more hands-on management approach and use metrics and quantifiable targets to measure performance.

Another area for reform could lie in the property rights regime. The original cooperative agreement with CASIS severely restricted patent and data rights for entities performing federally supported research, mandating that these rights were transferred to the government. Yet federally supported is a broad term that encompasses not only the experiment stage but also the pre- and post-analysis stages as well. These broad restrictions [changed the mix](#) of research conducted on the station, as explained in an IG report: “[ISS Users] have limited their participation to fundamental research not likely to generate significant intellectual property.” Other federal agencies have faced similar issues over the experiments and research at national institutions, leading to [a number of different technology-transfer mechanisms](#) that grant private entities access to the intellectual property generated through public-private partnerships.

In 2012, NASA and CASIS amended the agreement to route around these problems, but issues persist. NASA has even [proposed](#) legislation to amend the National Aeronautics and Space Act of 1958 that “includes revised provisions related to the retention of patent licenses and data rights on behalf of ISS National Lab users.” This legislation [still](#) hasn’t been introduced in Congress, however, and the lack of property rights could be a major problem for the development of a space economy, especially in the context of LEO where ownership of patents and data is critical in driving growth. The lack of access to intellectual property could be a disincentive for pharmaceutical and consumer-oriented companies that need ownership of patents and data to make the exorbitant costs of space research worthwhile, making this area ripe for reform.

Putting It Together

In his testimony to the Senate Commerce, Science, and Transportation Committee, Jim Chilton of the Boeing Company clearly stated the problem with privatization of the International Space Station: “Total ISS reliance on private funding is unlikely to be economically viable by 2025 absent significant, if not exclusive, NASA investment and anchor tenancy.”

This view is shared by NASA IG Paul Martin. In a Space Subcommittee hearing [testimony](#), he stated, “It is questionable whether a sufficient business case exists under which private companies can create a self-sustaining and profit-making business independent of significant Government funding.” He went on to say, “Candidly, the scant commercial interest shown in the Station over its nearly 20 years of operation gives us pause about the Agency’s current plan.”

Given these concerns raised by NASA’s IG, industry stakeholders, and the best cost-revenue estimates available, it is safe to conclude that the ISS can’t be sustained by private industry alone by 2025.

There is another option, however: a controlled, one-way ticket into the salty depths of the ocean.