Engine for Growth:
Analysis and Recommendations for U.S. Space Industry Competitiveness

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AEROSPACE INDUSTRIES ASSOCIATION


Virgin

Contents

Executive Summary

Having a strong domestic space industry is crucial to our nation's economic vitality and security. The U.S. space industry, which U.S. government national security and civil space programs increasingly depend upon, generates innovative solutions, export revenues and high technology jobs for our citizens, while underpinning our security in ways that are seldom understood by the public. Unfortunately, while the U.S. has long led in the commercial, civil, and national security space domains, foreign competitors are catching up—including aggressive efforts by potential military adversaries to close technology gaps—while some U.S. government policies are inadvertently exacerbating this situation.

The U.S. space industry, created by government investment in space activities over a half century ago and today delivering hundreds of billions of dollars in economic activity, is undergoing dynamic change, driven by growing demand for new space communications, imagery, launch services and passenger transportation. Enabled by technological innovation and supported by an infusion of investment capital, new commercial capabilities continue to emerge in sectors including space transportation, satellite servicing, space traffic management and soon, launching space tourists.

The U.S. national security community, one of the world's largest users of space capabilities, benefits from a thriving commercial sector in many ways, including lower prices for launch and other competitively procured services, a stronger industrial base and greater innovation. NASA's ability to conduct new civil space missions is also enhanced by a robust commercial space industry. Many of the same companies active in government space programs also build commercial systems, providing synergy across activities to customers and suppliers. In addition, many operators of commercial space systems in both telecommunications and imagery provide services to the U.S. Government and can augment dedicated national security systems.

Recommendations to Strengthen U.S. Space Competitiveness

1. Level the playing field

- Provide a responsive regulatory environment for U.S. space activities
- Update and improve export rulemaking and policies to reflect market and technological evolution and foreign competition
- Restore full functionality to the Export Import Bank of the United States (Ex-Im)
- Ensure that tax reform supports US-based space investment

2. Expand space market opportunities

- Preserve satellite spectrum to enable new innovative applications and systems
- Ensure a safe orbital operating environment through internationally accepted best practices
- Maintain national policies to ensure government does not compete with the private sector
- Modernize the Missle Technology Control Regime restriction to allow new space applications while protecting critical technologies

3. Prioritize space competitiveness

- Designate a senior U.S. government official as a space industry advocate along with a proactive National Space Council
- Encourage an enhanced leadership role for the Commerce Department's International Trade Administration
- Prioritize space security cooperation and designate a senior national security champion
- The Office of Commercial Space Transportation should be adequately resourced to support a growing industry and moved out of the FAA but remain within the Department of Transportation
- Adequately fund national security space and NASA's space technology investments

To capitalize on emerging opportunities, U.S. industry needs a proactive and responsive regulatory and policy environment aimed at enabling American industry's success. This report lays out several options for consideration by the new Administration and Congress that would give American companies their best chance to effectively compete. Industry friendly policies, balanced with national security and safety considerations, cost little, but can benefit the economy, the US military and civil space programs. These recommendations will also increase the impact of significant capital investments by the private sector.

Today, despite the importance of space, the advantages traditionally enjoyed by U.S. industry have eroded. Foreign governments have recognized the unique geo-strategic advantages that space offers, and are putting enormous resources into putting US assets at risk while attaining superiority and autonomy in critical functions. In addition to regulatory and policy changes, as the U.S. has done with aeronautics for a century and in space programs since the 1960s, we must adequately invest in national security space programs and in fundamental technology development to enable future long-term applications.

1. Maintaining a Level Playing Field

U.S. policies, taxes and regulations serve to either hinder or enable a competitive U.S. space industry. For example, the loss of U.S. global market share of satellites and components, and the rise of a more globally competitive industry followed the 1999 imposition of ITAR regulations on satellites and related technology exports. These restrictions limited or eliminated U.S. competition and prompted other countries to develop their own capabilities.

In 2014, the government rolled back a number of excessive satellite and related technology export restrictions. These long-awaited reforms provided a measure of relief, but did not go far enough in some areas, leaving in place restrictions on certain technologies that are now widely available from other countries, including close U.S. allies. This means U.S. companies are unnecessarily restricted from selling those technologies. The process for regularly reviewing and updating the rules to reflect market realities is moving far more slowly than technological change, market forces, and international competition.

U.S. companies are also at a competitive disadvantage in terms of access to export credit agency financing, which in recent years has become a significant factor in space commerce. The export credit agencies of France, China, Canada and others are highly active in the space market, providing loans and other financial support under attractive terms to international customers for their respective industries. Since July 2015, however, the Export-Import Bank of the United States has effectively been sidelined due to politics and it is currently unable to make loans of the size needed for space projects.

2. Expand Space Market Opportunities

Spectrum allocation challenges must also be addressed: there is an aggressive, ongoing campaign by the global wireless industry to reassign spectrum from advanced satellite uses, including commercial satellite industry, to wireless uses, both at the national and international levels. If we fail to provide adequate spectrum for satellite applications, this vital opportunity for economic growth could suffer. Similarly, while the U.S. has begun to consider a more active approach to space traffic management, an overly restrictive regulatory regime could encourage satellite operators to remain overseas.

3. Prioritizing Space Competitiveness is Vital to our Nation

While U.S. space policy has been supportive of the U.S. space industry, there is often a disconnect in implementation. For example, while hosting military communications payloads on commercial satellites would enable a more robust system by distributing assets, hosting on foreign satellites or launching on foreign rockets violates other policies and most communications satellites are owned by non-U.S. companies. The prevalence of non-U.S. satellite ownership or satellites is also encouraged by U.S. policies from corporate taxes to the lack of Ex-Im Bank financing.

Although commercial space already benefits national security and can improve resiliency and reduce costs, the need to continually modernize and recapitalize our dedicated national security space capabilities must not be forgotten. Although often unappreciated, virtually every U.S. military operation today depends on these "crown jewel" space capabilities and U.S. warfighters uniquely benefit from these asymmetric space systems. There is no commercial market for protected military satellite communications, national security surveillance capabilities and highly secure, jam-resistant global positioning; if we are to assure our national success in military operations and deterrence, these continued governmental investments are essential.

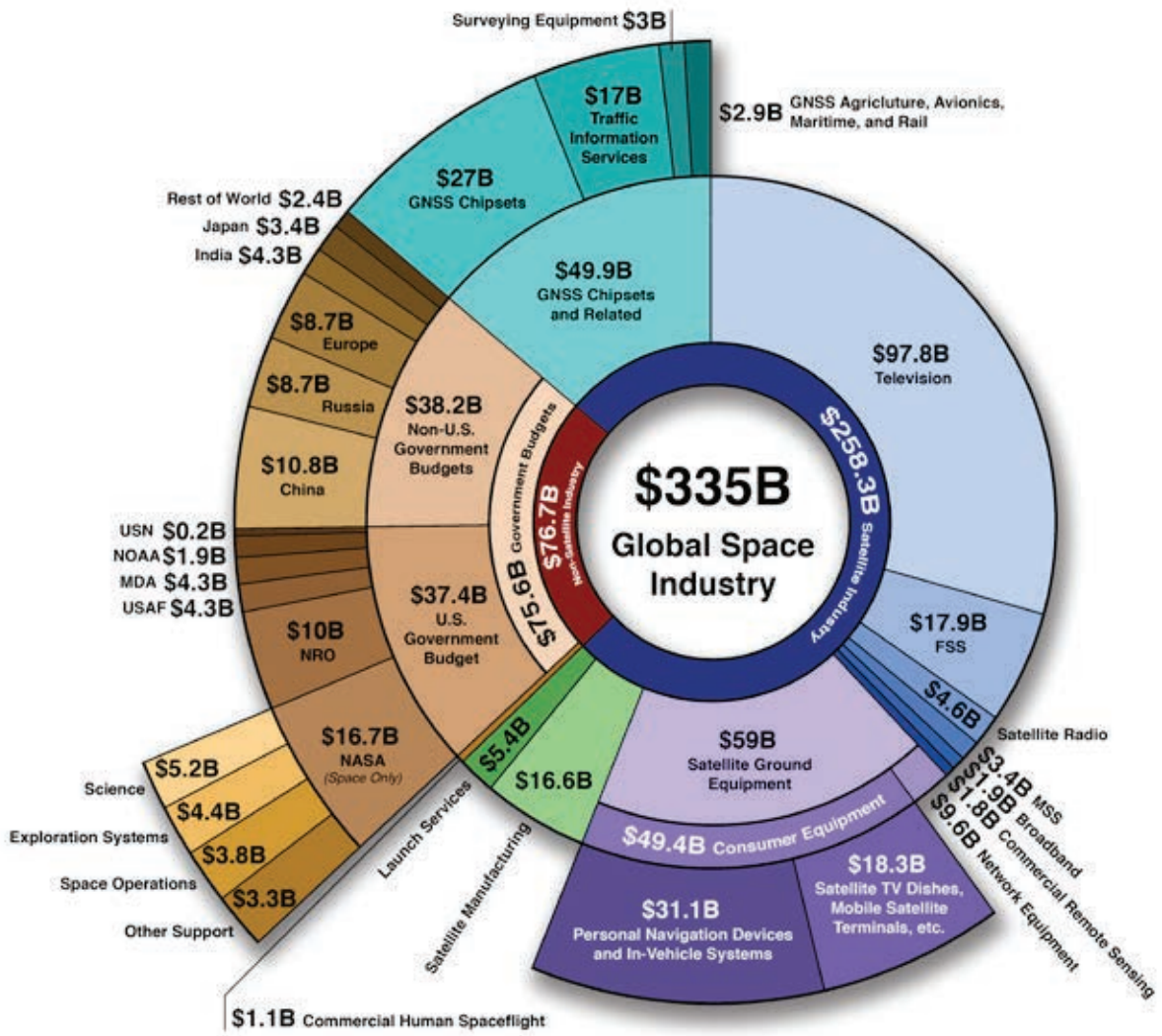
As the Trump Administration and Congress seek to restore American jobs and exports, space should be prioritized as a vital industry in a growing market. With a focus on Space Competitiveness, continued American space leadership can be parlayed into greater economic growth, improved national security and civil space capabilities.

Space: An Engine for Economic Growth and Innovation

Space capabilities like communications, navigation and imagery satellites have become an irreplaceable economic pillar in modern society. They offer near instantaneous communications no matter how remote the location, navigation signals for GPS devices, support precision agriculture and disaster response and provide timing signals for the world's stock exchanges. This impact shouldn't go unnoticed—the U.S. space industry pumps billions of dollars into the U.S. economy, generating thousands of high-paying, high-tech jobs, driving innovation and U.S. technological leadership, while making a positive contribution to the nation's balance of trade. Thus industry has significant upside potential—if the right policies, regulations and funding were in place—it's likely that the emerging space economy could become an even larger driver of national economic growth.

Like the power grid, highways or railroads, space capabilities enable new services and applications, which in turn lead to further applications and economic activity. As Figure 1 illustrates, the global space industry is now worth more than $335 billion. In 2015, satellite services, such as satellite TV and communications, accounted for $127 billion, or 38 percent of the sector's total value, followed by satellite ground equipment which accounted for $58.9 billion or 18 percent of total value. Sales of navigation receivers and GPS devices accounted for $49.9 billion, while satellite manufacturing and commercial launch services accounted for the remaining $23.1 billion, or 7 percent of total value.

Figure 1: State of Space Industry (2015). Source: Bryce Space and Technology.



Key Areas of the Industry's Impact

The U.S. space industry's impact goes far beyond the immediate economic activity of manufacturing and launching space systems. Indeed, the applications and efficiencies space systems enable touch almost every corner of the U.S. economy, spurring billions of dollars of economic activity and playing a key role in our daily lives. Examples include:

Navigation and Timing. The synergy between investments in national security space capabilities and commercial applications, is perhaps best illustrated by the U.S. Global Positioning System (GPS), an essential military capability with wide-ranging impact across our economy and society. Since the late 1980s, the precise timing and navigation signals provided by this constellation has enabled a wide variety of civilian services and applications including the synchronization of ATMs, cell phone networks, and transactions on the world's major stock exchanges. Used originally for navigation, GPS has enabled revolutionary new services such as Uber and Lyft and high efficiency precision agriculture. Increasingly, GPS use is also improving aviation fuel efficiency and is spurring new technologies such as autonomous drones.

Satellite Imagery. Satellite imagery, once the exclusive province of governments, is widely available today for scientific and commercial applications such as urban planning, agricultural monitoring, and business forecasting and decision-making. Coverage of the Earth by commercial imaging satellites is expanding as rapidly as the number of related applications, fueling a downstream market for geographic information systems and services. Startup companies like Planet and BlackSky Global are making it easier to access geospatial data or view live images of the Earth. The U.S. national security community has also come to rely on commercial imagery as an adjunct to its own capabilities.

Disaster Response. Satellites are also at the leading edge of rescue, response and recovery around the world. Since 1982, satellites operated by the National Oceanic and Atmospheric Administration (NOAA) have been used in more than 30,000 worldwide rescues at sea and on land. Commercial satellites have also been used for disaster mitigation and recovery efforts. For example, during the 2011 earthquake and tsunami disaster in Japan, geospatial intelligence was provided to Japanese authorities by satellite image provider Digital Globe. This imagery played a key role in the response to the nuclear emergency at the Fukushima power plant and provided a street-by-street view to alert first responders where victims may have been trapped in collapsed structures.

Weather Prediction. Weather satellites are the cornerstone of highly accurate weather forecasting that impact lives throughout the planet and the operations of nearly every sector in the U.S. and global economy. Today, more than 90 percent of all observational data used in three to seven-day forecasts for the National Weather Service come from satellites. This data informs forecasts for the civil, commercial and military worlds, including weather forecasts found in smartphone apps, television and radio reports, websites and newspapers.

Communications and Data. Communications satellites support everything from television delivery to Internet access in remote areas, business networks and mobile telephony. Most cable television programming makes at least part of its journey from production to the home via satellite. Satellite television companies like DirecTV and Dish transmit directly to homes, while more traditional cable service providers like Comcast use satellites to feed programming from widely dispersed sources to central distribution hubs linked to individual homes via cable networks. Communications satellites also enable airline pilots to receive and transmit critical flight and weather information, and give passengers access to in-cabin Internet service and entertainment. Commercial satellites also carry the majority of U.S. military satellite communications traffic.

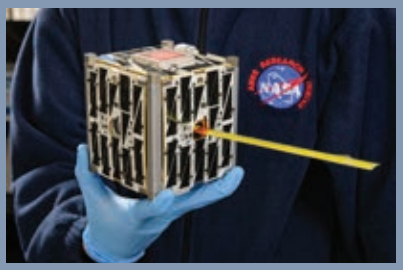
Emerging applications. Since the early 2000s, a growing number of new companies are developing systems and technology to enable everything from space tourism, commercial launch and a host of space-based applications that are revolutionizing how we access and use space. Virgin Galactic already has nearly 800 firm reservations for its suborbital space tourism experience. Companies such as Blue Origin, Boeing, Sierra Nevada and SpaceX, among others, are developing commercial service capabilities to launch U.S. astronauts, astronauts from other nations, and even private citizens to destinations in space. Meanwhile, Planetary Resources is working to identify mineral rich asteroids and the systems needed to mine them, and established satellite companies like Boeing as well as newcomers such as OneWeb are proposing constellation of hundreds to thousands of low Earth orbiting satellites to provide Internet services from space. Developments such as these could dramatically impact the global economy.

The Market for Space is Growing

Today, new and established space companies are being driven by innovations which have real potential for growth. The number of commercial satellites being launched each year—some of which are piggybacked on launches of larger government or commercial payloads—is also growing. Included in this increase are replacement satellites for telecommunications constellations like Iridium, and small satellites, including cubesats, whose capabilities have grown dramatically in recent years.

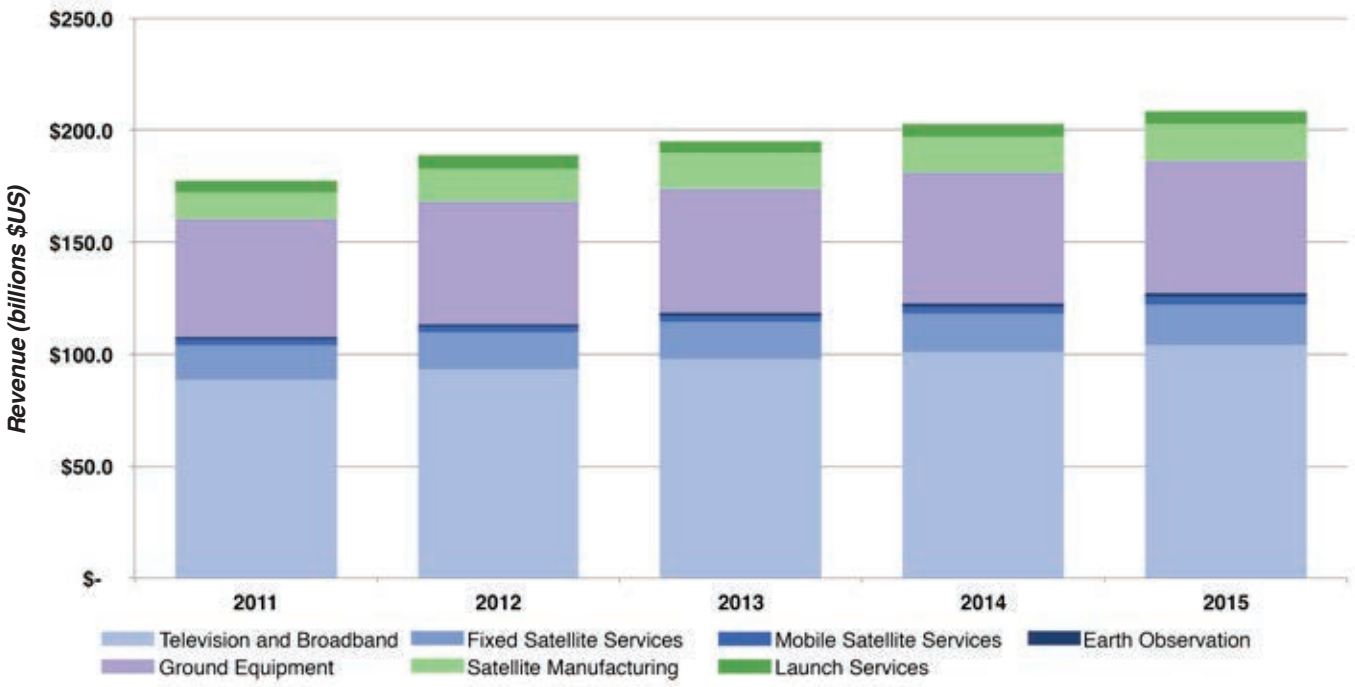
In the decade ahead, we may see even more new satellite deployments driven in large part by skyrocketing demand for Internet connectivity, especially for mobile users. Technology giant Cisco Systems observed in a 2016 report that global mobile data traffic reached 3.7 exabytes—one exabyte is equivalent to 1 billion gigabytes – per month by the end of 2015, up from 2.1 exabytes per month at the close of 2014. By 2020, Cisco Systems' report said, monthly global data traffic will reach 30.7 exabytes.

To meet this demand, several companies have proposed constellations featuring hundreds or even thousands of low Earth orbiting satellites to deliver broadband Internet services anywhere on the globe. These new systems can bring the entire world online and enable new services such as Uber and Airbnb to create new markets.



Cubesats are satellites whose basic building blocks are cube-shaped modules measuring 10 centimeters on each side. Once limited largely to experimental applications, cubesats today are being used for operational missions including imaging, weather-monitoring and communications. Image: NASA.

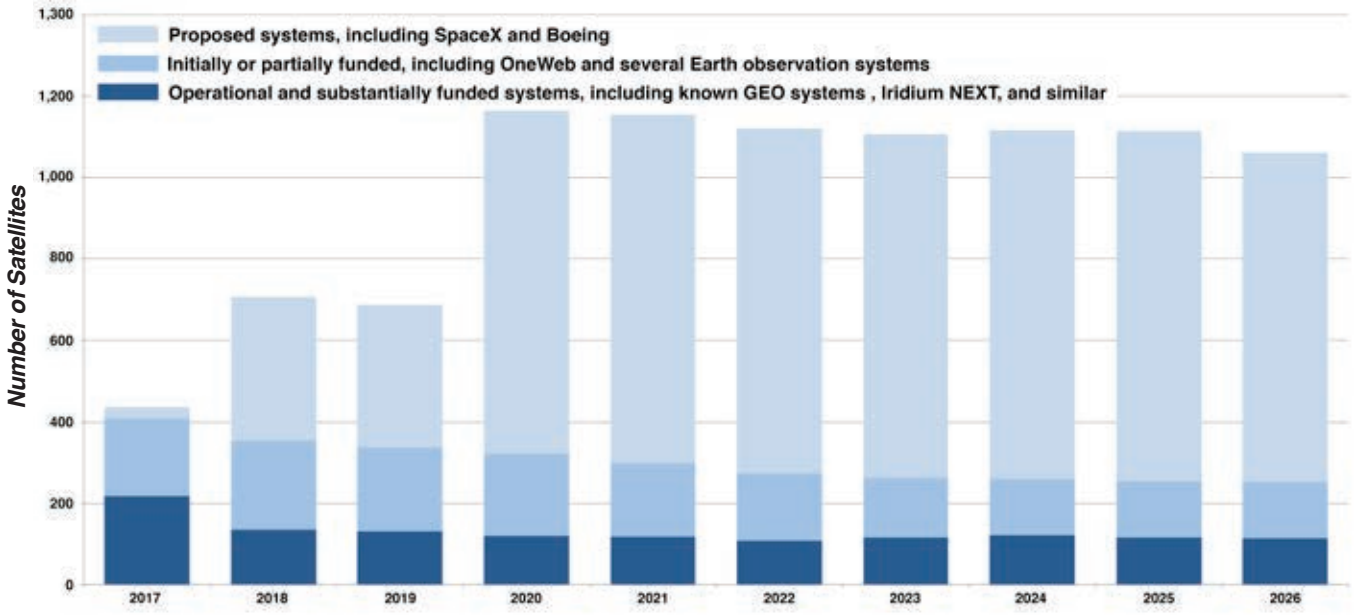
Figure 2: Worldwide Growth in Satellite Services, Satellite Manufacturing, Launch Services, and Ground Equipment (2011-2015). Source: Satellite Industry Association and Bryce Space and Technology.



In addition to internet connectivity, new low Earth orbiting constellations consisting of very simple imaging satellites are being deployed by the company Planet. The result is akin to a line scanner for the world—providing a rich and frequently refreshed data stream from space that can support a wide range of end users from agriculture to first responders.

Significant investment is needed to develop and launch these huge new satellite constellations. Some of these mega-constellations have already drawn investor support. OneWeb initially raised $500 million from an investor group that includes Coca-Cola and chipmaker Qualcomm, and recently announced an additional $1.2 billion in funding. Figure 3 places the proposed new satellite systems in three categories: substantially funded systems, which includes established operators like Intelsat and Iridium; partially funded systems like the proposed OneWeb constellation; and more speculative systems such as SpaceX's proposed 4,000-satellite constellation.

Figure 3: Planned and Proposed New Satellites. Source: Bryce Space and Technology.



While major capital investment does serve as a metric for business case viability, as with any new market opportunity, not all proposed constellations will be built. Satellite ventures targeting new markets with large constellations of small satellites are in the early stages of proving their business cases, and face significant risks. Despite the uncertainty, several established satellite and component manufacturers are already preparing for the challenge. As shown in Table 1 and table 1A on the next page, new investment capital is enabling new applications for satellites, as are technological advances in both hardware and data analytics.

Foreign Competitors See an Opportunity

The U.S. government has played a positive leadership role in fostering the creation of new satellite-enabled service industries. In recent years, however, government policies on spectrum allocation, export controls and efforts to end government export financing by some in Congress has significantly harmed the U.S. space industry. All the while, other nations have recognized the industry's potential for new growth and are posturing to enable their industries to take advantage of emerging opportunities. The international expansion of government space activity, both among traditional spacefaring nations and newcomers, is providing potential new markets but also new challenges for U.S. industry. Table 2 on page 10 displays the amounts that key nations are spending annually on space, and the primary focus of that spending.

Table 1: Major Investors in Emerging Space Companies. Source: Bryce Space and Technology.

Investor	Investment Recipient/Company	Amount	Year	Capability
Inmarsat	Global Xpress Ka-band satellite constellation	$1.6B	2010	Space broadband
Softbank	OneWeb	$1.2B	2016	Space WiFi
Google/Fidelity	SpaceX	$1B	2015	General
Consortium (including Coca Cola)	OneWeb	$500M	2015	Space WiFi
Google	Terra Bella (formerly Skybox Imaging)	$500M	2014	Earth observation
Aabar Investments of Abu Dhabi (UAE)	Virgin Galactic	$280M	2009	Space tourism and launch

As an example of this trend, China's space program, both in terms of its national program and development of commercial technology, has grown dramatically. Although China is not a market opportunity for U.S. industry—most countries' national space programs are served by their domestic industry—it has the potential to someday challenge the U.S. for global leadership in space. China's industry already is very active in the commercial space market as a lower-cost alternative to U.S. space companies, and many foreign competitors use their launch vehicles to launch ITAR-free commercial satellites.

More broadly, the Asia-Pacific satellite industry has become one of the most dynamic markets for space today, with countries such as Laos, Bangladesh, and Myanmar buying and launching their first telecom satellites in recent years. Private operators are also actively bringing about new satellite systems adding to capacity supplied from other regional and global operators. In 2016, Singapore launched its first domestically built remote sensing satellite last year, and the Philippines, through the Japan Aerospace Exploration Agency (JAXA), deployed its first domestic Earth observation satellite.

India is also becoming an increasingly influential space industry player. Last year, India's national space organization, the Indian Space Research Organization (ISRO), launched the Indian regional navigation satellite system constellation, which is designed to provide positioning data for the country's civilian and military users. Elsewhere, countries such as Kazakhstan, Peru, Spain, Taiwan, Thailand, and the United Arab Emirates have been investing in new technology and fielding satellites.

Table 1A. Number of Investors in Start Up Space Companies (2000-2015). Source: Bryce Space and Technology.

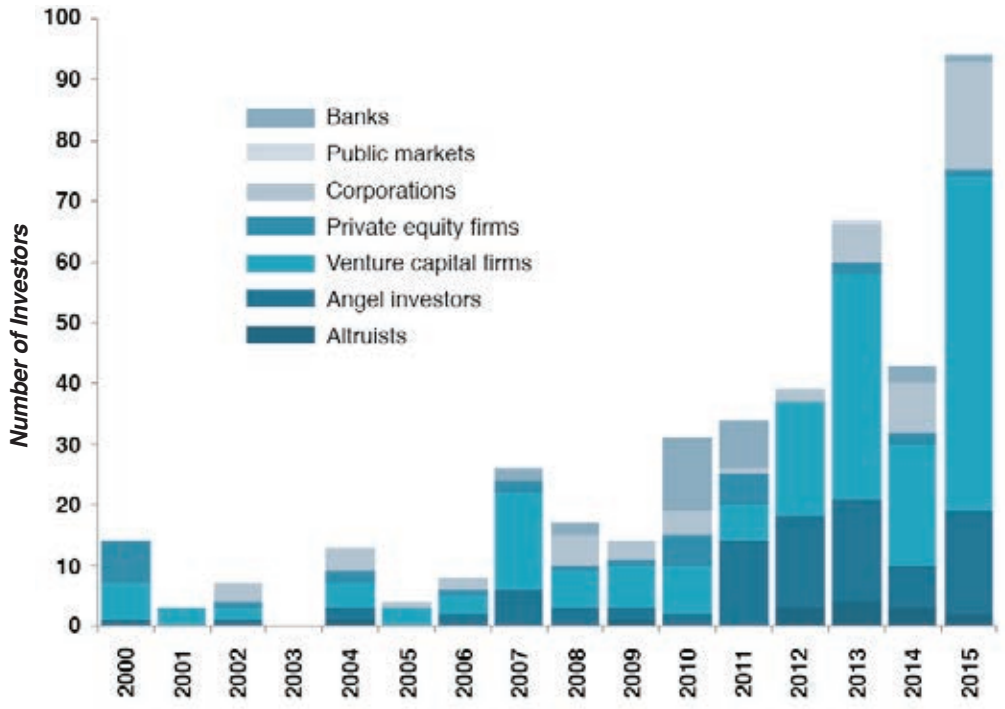


Table 2: Major Players in the Global Space Systems Marketplace (by Government Space Budget).

Country	Government Space Budget ($B)	National Budget ($B)	% of National Budget Dedicated to Space	National GDP Growth Rate	Space Highlights
USA	$38.1	$3,688	1.03%	2.4%	USG space budget equals rest of world combined. Sophisticated industrial base encompassing satellites, space and Earth science platforms, GNSS, human spaceflight, and emerging space sectors.
China	$10.8	$2,822	0.35%	6.9%	Significant government commitment in space endeavors. Third human spaceflight nation. Launch cadence equals that of U.S.
Russia	$8.7	$256.3	3.39%	-3.7%	Space heritage rivals that of U.S., with sophisticated space industrial base. Highest launch cadence for many years, except 2016. Trending downward in terms of expenditures and number of programs.
European Space Agency	$5.7	--	--	--	Twenty-two member states provide about three-quarters of ESA's annual budget. One-quarter of the agency's budget is provided by the Euroepan Union and EUMETSAT.
India	$4.3	$276	1.54%	7.6%	Emerging space power, with significant investment in space programs. In 2015, became the third country to reach Mars (after U.S. and USSR/Russia). Wide range of independent launch capabilities.
Japan	$3.4	$1,704	0.2%	0.5%	Regional space power with robust industrial base. Strong space science and remote sensing capabilities.
France*	$2.4	$1,380	0.18%	1.2%	Home to Arianespace and Airbus, represents largest center of space manufacturing and operations in Europe.
Germany*	$1.6	$1,474	0.11%	1.7%	Strong space industrial base, second only to France.
Italy*	$1.2	$917	0.13%	0.8%	Significant space power despite small size.
UK*	$0.5	$1,232	0.04%	2.3%	Formally minor player in space, now a growing influence, with increasing expenditures and robust programs. SSTL and Clyde Space are notable.
South Korea	$0.4	$300	0.14%	2.6%	A growing regional space player. Early launch capabilities.
Canada	$0.4	$626	0.06%	1.1%	Major U.S. partner in space activities, especially human spaceflight.

** These countries contribute a percentage of their annual space budgets to ESA. France contributes about 23%, Germany 23%, Italy 14%, and the UK 9%.*

Space budgets: OECD Space Economy at a Glance (2014), national budget data from CIA Fact Book, U.S. budget data from the Congressional Budget Office, and annual growth rate data from World Bank.

Continuing Commercial Challenges

Despite new opportunities, and ongoing investment in commercial space activities, the U.S. space industry still faces regulatory and policy challenges, which threaten to weaken its leadership in an increasingly competitive global marketplace.

Export Reform Fell Short and Took Too Long to Implement

The long-awaited U.S. government export control reforms, released in 2014, brought much needed relief to the US space industry, but in some areas, these reforms fell markedly short.

When the interim final rule on satellite export reforms was published in 2014, the U.S. government correctly anticipated that periodic reviews would be necessary to reflect technological development and market realities. The first update took nearly two and a half years, some two years longer than expected. On January 10, 2017, the Federal Register published these revisions to Category XV of the U.S. Munitions List under ITAR. While these long-awaited changes were certainly a step in the right direction, the prevailing view among many satellite imagery instrument companies is that they do not go far enough in supporting the commercial space industry, particularly regarding the limits placed on camera aperture size.

U.S. imagery and satellite companies had sought to increase the aperture-size threshold for keeping satellites on the USML from 0.35 meters up to 1.1 meters. The Commerce Department, however, responded with a revised threshold of 0.50 meters – far below what industry expected, even though international imaging instrument competitors already sell systems that are more capable. Table 3 shows that, as far back as 2004, international companies were selling imagery satellites with a larger aperture than what was approved for U.S. companies in 2014!

Under the new export rules, satellite imaging cameras with an aperture of 0.5 meters or greater cannot be exported, even though multiple satellites sold internationally by non-U.S. companies have exceeded this threshold (see Table 3 below). Aperture is a measure of the size of the instrument's opening and, while not the only factor, it is closely tied to the resolution of the imaging system.

Table 3: Missed Opportunities for American Companies. Source: AIA.

Satellite	Launch Date	Operator	Operator Country	Manufacturer	Maximum Resolution (m)	Aperture Diameter (m)
BilSat-1	9/27/03	TUBITAK-UZAY	Turkey	SSTL (UK)	4	0.6
Rocsat-2	5/19/04	National Space Program Office	Taiwan	EADS Astrium/Airbus (France)	2	0.6
THEOS	10/1/08	Geo-Informatics and Space Technology Development Agency	Thailand	EADS Astrium/Airbus (France)	2	0.6
DubaiSat-2	11/21/13	Emirates Institution for Advanced Science and Technology	United Arab Emirates	SATREC (South Korea)	1	0.42
KazEOSat-1	4/30/14	Kazakhstan Gharysh Sapary	Kazakhstan	EADS Astrium/Airbus (France)	1	0.64
Deimos-2	6/19/14	Deimos Imaging SL (Planet)	USA	SATREC (South Korea)	0.75	0.42
PerúSat-1	9/15/16	Fuerzas Armadas del Perú	Peru	Airbus (France)	0.7	0.64

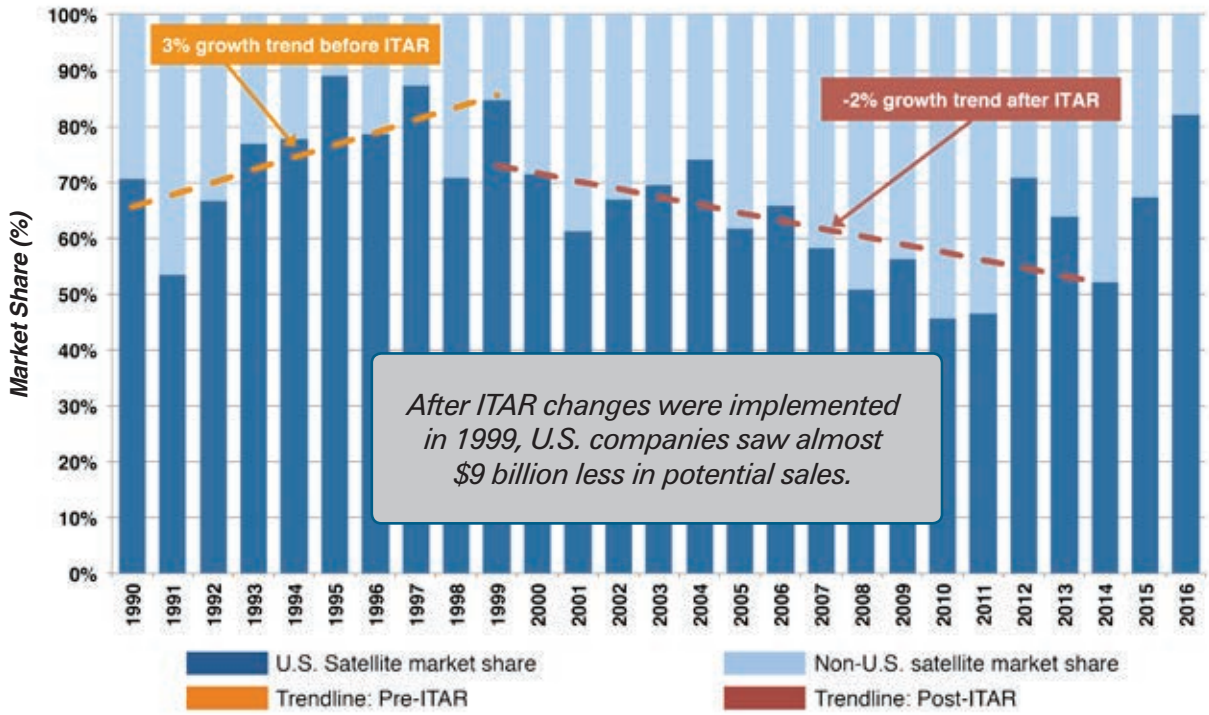
Finally, the new rules defined all "man rated" spacecraft as defense articles, using that terms as the sole controlling qualifier for categorization. The interim final rule did not identify the reasons why man rated spacecraft or habitats, including commercial suborbital craft, possess special military qualities that warrant additional regulatory constraints. Several of the technologies that remained tightly restricted are widely available from other countries that do not have similar controls—placing U.S. industry at a competitive disadvantage.

For suborbital vehicles, the qualifier of man-rated was removed before the final rule was published. But the rule was further revised to control all suborbital craft (both manned or unmanned) that utilize certain propulsion methods or exceed specified engine thrust limits. For companies such as Virgin Galactic, the exclusion of rocket engines which provide greater than 150 lbf vacuum thrust from the list of technologies taken off the munitions list spans the performance range for manned commercial and scientific suborbital systems. This further limits their commercial efforts to sell, lease, or operate their craft outside the United States.

Case Study: ITAR and Market Impacts on the U.S. Commercial Space Sector

The mid-to-late 1990s saw a boom in the commercial space industry that was driven by multiple factors, including the rise of the Internet, limitations on existing cellular telephone networks, the privatization of quasi-government satellite communications giants Intelsat and Inmarsat, and a gradual relaxation of U.S. government controls on space technology. As shown in Figure 4, U.S. companies were dominant in the international satellite market during the 1990s, in some years garnering nearly 90 percent of total revenues.

Figure 4: U.S. Market Share by Number of Satellites. Source: Bryce Space and Technology.



** Loss is calculated based on revenue that would have been achieved had US maintained average pre-ITAR market share of 78%.*

The U.S. Department of State reclassified satellites and several related components so they are no longer treated as munitions whose export is controlled under ITAR. As of November 2014, these are covered under the Export Administration Regulations. In 2016, the U.S. revenue share appears much higher due to the September explosion of a SpaceX Falcon 9 rocket that pushed the launches of several European satellites into 2017, effectively increasing U.S. market share for that year.

In 1999, Congress passed restrictions on exports of satellites and satellite-related technology in response to concerns that China took advantage of U.S.-made commercial satellites to improve its missile technologies. The new law mandated that all satellite-related technology, hardware and know-how, regardless of sophistication or application, be placed on the U.S. Munitions List (USML), a registry of military technologies subject to the highly restrictive International Traffic in Arms Regulations, or ITAR. Exports of ITAR-controlled items are licensed by the Department of State.

Before the law was passed, a growing number of commercial space hardware and technology items were being moved to the less restrictive Commerce Control List (CCL), whose exports are licensed by the Commerce Department.

Declining Fortunes for U.S. Industry

As Figure 4 illustrates, U.S. market share declined after the new export control regime took effect in 1999. Although revenues in the chart were tallied based on when the satellites were launched (typically satellites are launched about two years after being ordered), the impact registered almost immediately because the State Department denied export licenses for at least two satellites that were well under construction before the new rules took effect.

In addition to export restrictions, other factors contributed to the reduced U.S. commercial market share. One was the launch of large low orbiting constellations of U.S.-built satellites, the bulk of which took place before 1999. Another was the decision by some commercial manufacturers to refocus on the U.S. government market.

Component Suppliers Feel the Pinch

Satellite manufacturers were not the only segment to suffer from the market decline. Component suppliers were also affected, regardless of whether their products were sophisticated electronics like travelling wave tube amplifiers or the simplest of fasteners. A 2002 report by the Center for Strategic and International Studies (CSIS), shows that U.S. component suppliers had 90 percent of the market in 1995 but saw that share decline to 56 percent by 2000.

The CSIS report adds that during that period, the European share of the component market increased from 10 percent to 34 percent. Evidently, European satellite manufacturers, traditionally reliant on U.S.-made components, became frustrated as the new licensing rules made these parts tougher to get. Furthermore, because they contained U.S. hardware, the European satellites became subject to U.S. rules, including an outright ban on launching on Chinese rockets. One European company, Thales Alenia Space, responded by developing a so-called ITAR-free satellite—that is, a satellite devoid of U.S. components—which it exported to countries like China. U.S. component suppliers complained at the time that ITAR-free satellites were hurting their business.

Not only did European companies seize the opportunity to catch up in both market share and technology for communications satellites, they effectively cornered the emerging market for imaging platforms, where the U.S. technical edge was far greater. In fact, the U.S. industry has yet to register a single export sale of a high-resolution imaging satellite, while European companies have made several such sales internationally.

National Security Impact

The reduced international market share for our commercial space industry also negatively impacted U.S. national security. The reduction strained the U.S. industrial base that the Defense Department relies on to build its own satellites, while encouraging investment by other countries in militarily significant technologies. In other words, rules enacted to enhance U.S. national security wound up doing the opposite.

In recent years, U.S. companies have regained market share. This gain could be attributed in part to the reforms enacted in 2014 that transferred many space related items back to the less restrictive Commerce Control List, but it is too early to know for certain if that is the case. A 2012 spike in U.S. market share—two years before the reforms took effect—likely occurred due to a production backlog at one of the major European manufacturers, Thales Alenia Space.

The Critical Role of the Export Import Bank of the United States

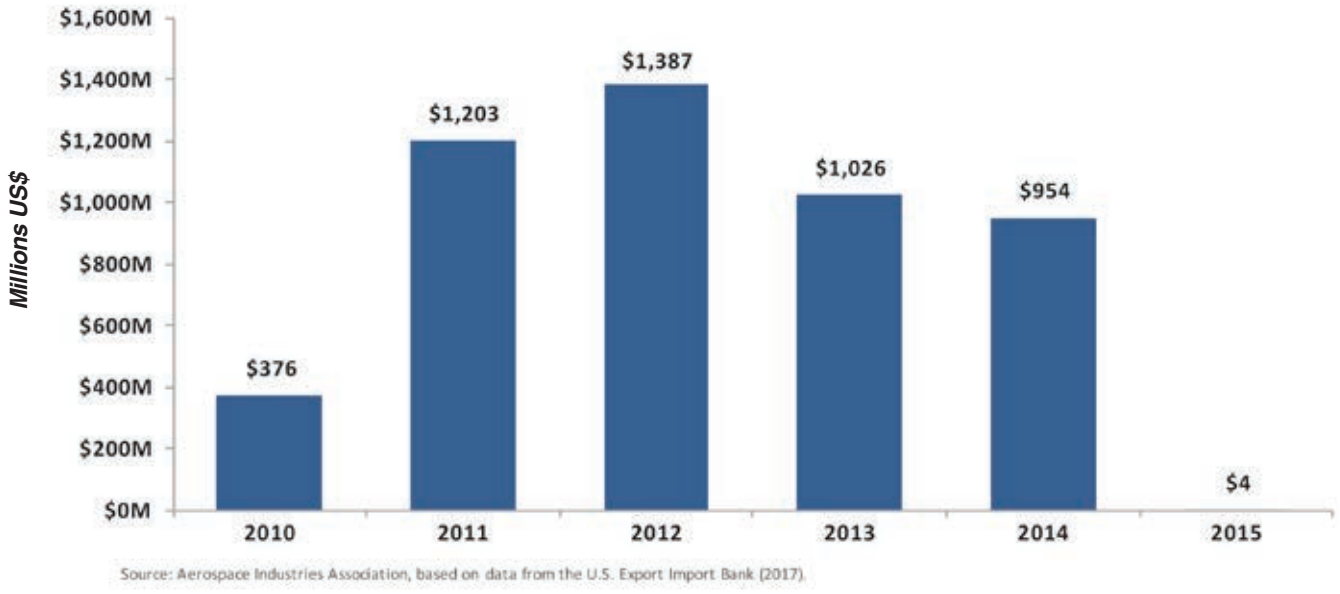
Financing from export credit agencies, which facilitate exports to customers with limited ability to obtain commercial credit, is often a key competitive factor in international satellite manufacturing and launch service deals. Most developed countries active in the global space marketplace offer such financing in some capacity and often, such financing is needed as developing nations seek to rapidly modernize their terrestrial communications infrastructure with space systems.

By early 2014, space financing support had become the fastest-growing sector at the Export-Import Bank of the United States (Ex-Im), growing from $50 million to nearly $1 billion per year since 2010. More than 60 percent of all U.S.-built commercial satellites were financed by Ex-Im, which between 2010 and 2014 had approved 16 major loans in the sector with a combined value of more than $4 billion.

Ex-Im helps to level the international playing field for U.S. companies; the Bank's prudent lending practices have led it to consistently be a cash positive contributor to the U.S. Treasury. Moreover, by aiding U.S. exports, the Bank has helped the strategically important space industry to weather downturns in U.S. military space spending. Ex-Im opponents cite strongly held free market beliefs when criticizing the Bank, but global markets do not work freely. When international competitors have access to such credit and American companies do not, it unilaterally disarms American companies, hurting the nation's industrial base and strengthening foreign competitors.

Since July 2015, Ex-Im has been unavailable to large U.S. exporters, owing first to a delay in Congressional reauthorization and, more recently, extended vacancies on the Bank's Board of Directors, whose members must be Senate confirmed. As a result, Ex-Im authorizations for satellite and launch services dropped from nearly $2 billion in 2013 and 2014 to roughly $4 million in 2015, with at least two U.S. satellite makers saying they have lost business due to the lack of available Ex-Im financing. If the situation is not changed, reduced sales of commercial satellites will eventually impact national security program costs as the fixed costs of satellite design, manufacturing and test are spread out over a smaller customer base.

Figure 5: Ex-Im Bank Satellite and Launch Service Authorizations. Source: AIA, Based on Data from the U.S. Export-Import Bank (2017).



Orbital Debris and Space Traffic Management

Increasing space activity has led to a proliferation of orbital debris, including spent-but-intact satellites, rocket stages and debris from rocket launches, on-orbit breakups and other events. In 2009, an inactive Russian military satellite collided with an operational Iridium communications satellite, creating thousands of pieces of potentially hazardous orbital junk. This event reminded the world that even the tiniest piece of such debris, traveling at five miles per second, can cause catastrophic damage to other spacecraft or, potentially, harm the safety of orbiting astronauts.

While the world's leading spacefaring nations have agreed on nonbinding design and operating rules designed to minimize debris creation, these guidelines are not always followed by adversary nations or new space actors who may lack the requisite design capability. Thus, the threat may grow as more and more nations and other actors become involved in space activity. Also, with the increasing proliferation of nanosatellites—very small but capable spacecraft made possible by improved satellite technologies—new risks may develop as more objects are launched into space. So far, no credible debris removal system has been developed.

These potentially threatening developments have led to some calls for a regulatory regime similar the civil aviation air traffic control system—usually described as space traffic management. Clearly, there is merit in having good space situational awareness and in following sound practices to preclude debris creation and responsibly dispose non-functioning satellites to safe orbits away from active systems. Good practices can make a big difference; for instance, Boeing's planned LEO constellation of WiFi satellites is being designed to lower the spacecraft's orbit at the end of their usefulness to facilitate re-entry. When considering a space traffic management regime, however, it is important to assure that future traffic management regulations imposed on U.S. operators do not simply encourage U.S. firms to move their space operations overseas to nations with less onerous requirements.

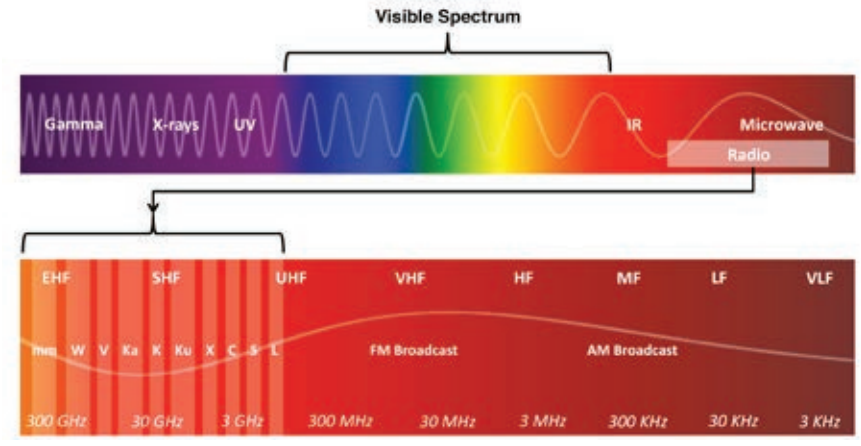
Access to Radio Frequency Spectrum

Radio frequency spectrum is vital for both commercial and government users. Satellites use this spectrum for command and control, Earth imaging and remote sensing as well as to provide communications and other capabilities. Next generation systems are already under development that will provide customers with services such as daily global Earth imaging and faster ubiquitous satellite-broadband at lower latencies.

Unfortunately, the limited spectrum available to support these and new innovative satellite services is under constant threat, both domestically and at the international level, as the terrestrial wireless industry seeks to gain access to additional spectrum. The satellite industry, in particular, has seen erosion of its rights to certain C-band frequencies at the International Telecommunication Union, the United Nations affiliate that regulates radio spectrum.

Another worrisome trend within the U.S. was the previous Federal Communications Commission (FCC) Chairman's decisions to disrupt globally harmonized spectrum bands devoted to satellite systems. Globally harmonized spectrum access is particularly important to satellite systems, many of which cross over many countries each orbit. Despite this fact, recent FCC decision making has ranked other uses of spectrum over satellite uses, disrupting years of efforts to secure globally harmonized satellite spectrum and imperiling U.S. space leadership.

Figure 6: The Electromagnetic Spectrum and the Radio Spectrum. Source: Bryce Space and Technology



In July 2016, for example, the FCC adopted rules that favored mobile wireless use of the Ka-band frequencies over the next generation of satellite broadband systems, both existing and planned, representing billions of dollars of investment. This was preceded in 2015 by another FCC decision that imposed constraints on existing and future systems' use of parts of C-band satellite spectrum, in favor again of another spectrum use.

Taxation Policies and Investment Incentives

International tax competitiveness is an important factor that can hinder or help the space industry. It is widely agreed that the U.S. has an uncompetitive corporate tax code, higher than most developed nations' and needs reform. The first major overhaul since the Tax Reform Act of 1986 is long overdue.

One area where favorable tax policies can positively influence corporate activity is in satellite telecommunications. Interestingly, among the world's top five fixed satellite service operators, none are headquartered in the U.S. The top two, SES and Intelsat, are headquartered in Luxembourg, even though Intelsat traditionally was U.S. based and still maintains substantial operations here (Recently announced plans to merge Intelsat with One Web may change this situation but the merger has yet to be finalized).

Luxembourg may have recently emerged as the "Delaware" of space company headquarters because of its low corporate tax rate of 21 percent (vs. 36 percent in the U.S.), a business-friendly legal and regulatory framework, low fees for sending capital in and out of the country, significant investment and R&D incentives (which can reimburse up to 45 percent of a company's R&D investment), and political and economic stability. Additionally, Luxembourg offers businesses access to Luxinnovation, the national agency that promotes innovation and research, through the Luxembourg Space Cluster. The Cluster brings together enterprises and research laboratories, as well as financial support in the form of government loans, direct equity investments and other financial mechanisms.

Today, many other countries noticing the Luxembourg model are promoting more business-enabling environments that include favorable tax policies and related infrastructure. They are attempting to position themselves in the coming years to gain increased market share of the global space industry.

Investment Incentives

Some countries, such as the United Kingdom (UK), are making great strides in fostering a business-friendly environment that includes both government-backed research and development support, combined with early stage financing and other investment tools aimed at growing and supporting their domestic space industry. Investment examples include:

- A Spaceflight Bill that leverages $12.5 million recently was announced by the Department for Business, Energy and Industrial Strategy to boost the UK's commercial spaceflight market. These subsidies will be directed to UK companies with the best plans to foster a space industry within the UK through the development of spaceports for satellite and sub-orbital launches, which could include space tourism.
- The British government invested $250 million in 2013 to develop space technologies, including $170 million for Astrium to develop the next generation of weather satellites and $75 million for SABRE - a British-designed high efficiency rocket engine.
- Innovate UK (previously the Technology Strategy Board) created the Catapult program to promote research and development through business-led collaboration between scientists and engineers aimed at transforming the UK's capability for innovation. There are 11 separate not-for-profit, independent Catapult Centers, one of which is solely focused on satellite applications. The Satellite Applications Catapult center is funded three ways: 1) through business-funded R&D contracts; 2) collaborative applied R&D projects from the UK and Europe; and 3) core UK public funding.
- Catapult's Satellite Applications Center recently announced the creation of the Seraphim Space Fund, a $100 million investment focused on space-related technology businesses, which is backed by a $38 million investment from the British Business Bank, and investment capital from leading international space companies and individual investors. The fund will invest in commercial applications in both software and hardware opportunities, as well as in technologies that have potential space applications such as artificial intelligence, robotics and nanomaterials.

New 21st Century Space Transportation Capabilities

U.S. export control and missile technology nonproliferation policies have not kept pace with some of the newest developments in commercial space transportation, including the emerging market for space tourism. While companies have made great strides to make this once seemingly farfetched business a reality, regulatory policies established in the 1970s and 1980s, when the applications for commercial activities were far more limited, now threaten to limit their business potential.

Virgin Galactic, for example, is developing vehicles to carry paying passengers to the edge of space, with plans to begin commercial operations in the next couple of years. Virgin Galactic's SpaceShipTwo suborbital space tourism vehicle launches at altitude from a carrier aircraft (as will the company's Launcher One small satellite launcher). Similarly, Sierra Nevada Corporation's orbital Dream Chaser vehicle will be used to deliver cargo to the International Space Station under contract to NASA. Either of these systems could also be used for other missions involving international customers. But these opportunities are made more difficult by the Missile Technology Control Regime, an international nonproliferation pact.

Thirty years ago, the United States and its G-7 partners (Canada, France, the Federal Republic of Germany, Italy, Japan, and the United Kingdom) announced the formation of the MTCR. This partnership's goal is the non-proliferation of missiles capable of delivering Weapons of Mass Destruction (WMD). Based on our adherence to the MTCR, the U.S. has pledged to subject the review of exports with a range of greater than 300 km and a payload of 500 kg (i.e. "Category I" systems) to a "strong presumption of denial." These restrictions are on top of already stringent foreign policy and national security assessments required by the U.S. Arms Export Control Act.

While this international agreement has curtailed the proliferation of missiles capable of WMD delivery, the MTCR restrictions and, by extension, U.S. policy is outdated since it does not differentiate between commercial space vehicles and missiles. This overly rigid implementation of the MTCR may harm US industry without improving security. For one example, new commercial human space flight systems are at risk of being severely limited by MTCR since they typically include rocket engines with more than 150lbf vacuum thrust - placing regulatory constraints on the performance necessary for crewed commercial and scientific suborbital flight, limiting commercial efforts to sell, lease, or operate such systems outside the United States.

Although sometimes portrayed as unchangeable, the MTCR is a voluntary regime under which the decision to export is the sole responsibility of each member state. Each MTCR member is expected to establish national export control policies for ballistic missiles, space launch vehicles, sounding rockets, and underlying components and technologies that appear on the regime's Material and Technology Annex. The U.S. government has this flexibility since the MTCR allows members to add or remove items from the annex through consensus decisions and no member can veto another's exports.

National Security and Commercial Capabilities

Commercial space capabilities emerged as a factor in military operations during the 1991 Persian Gulf War, when the U.S.-led coalition utilized commercial imagery in real time operations. During the first "Gulf War," the U.S.-led coalition was not only a major buyer of imagery from the French government-owned, commercially operated Spot satellites, but also negotiated an arrangement to keep that data out of the hands of Saddam Hussein. One of the major benefits of commercial imagery is its unclassified nature, which allows it to be readily shared with coalition nations, postwar relief organizations and used in international policy discourse. For example, Spot imagery proved highly valuable in the final negotiations leading to the 1995 Dayton Accords that ended the devastating civil war in the former Yugoslavia.

Recently, U.S. national security dependence on commercial space assets has dramatically increased. When the U.S. military engaged in post 9/11 operations in Afghanistan, and later in Iraq, U.S. forces were perilously short of satellite communications capacity, in part because the Air Force and Navy, operators of two key satellite constellations, were in the early phases of their fleet recapitalization programs. Fortunately, the commercial satellite telecommunications industry, after a period of unprecedented growth during the late 1990s, had capacity to spare. Later, in Operation Enduring Freedom (Afghanistan) and Operations Iraqi Freedom/New Dawn (Iraq) the majority of the satellite capacity—up to 80 percent by some accounts—used to support U.S.-led forces was commercially procured from international geostationary satellite operators.

Similarly, the U.S.-led coalition's demand for high-resolution satellite imagery in the Afghanistan and Iraqi theatres exceeded supply at the time. This was due in part to a delay to a key classified program. Fortunately, military planners were able to enlist commercially deployed satellites with unprecedented imaging precision to support coalition efforts. As it had done a decade earlier with Spot, the Pentagon negotiated deals with two satellite companies to ensure that high-resolution commercial satellite imagery of the theater stayed exclusively in allied hands.

Despite the slowdown of U.S. operations in Afghanistan and Iraq, the DoD today remains heavily dependent on commercial satellite capabilities, both for communications and imagery. Meanwhile, the DoD remains the biggest and arguably most important single customer for both industries.

The Government Accountability Office reports that the Defense Department's use of commercial satellite bandwidth increased by more than 800 percent from 2000 to 2011. In 2012, the DoD purchased more than $1 billion worth of commercial satellite telecom capacity.

Military demand for commercial bandwidth remains strong even though the Pentagon over the last decade has substantially deployed its 10-satellite Wideband Global Satcom system, which provides a dramatic bandwidth increase over the legacy Defense Satellite Communications System. Air Force Gen. John "Jay" Raymond, now commander of Air Force Space Command, told Space News last year that 60 to 80 percent of U.S. military satellite communications traffic is commercially procured. Military unmanned aerial vehicles, to cite just one example, are heavily dependent on commercial satellites for command and control and to transmit the vast amounts of data that they collect. Overall, the Pentagon's satellite communications requirements are projected to increase by 70 percent over the next decade.

In addition to buying services, the government has also directly leveraged commercial satellite production lines for its own unique purposes. In 2013, for example, an unspecified U.S. government agency contracted with Boeing for three satellites featuring all electric propulsion systems, leveraging a design that Boeing had recently introduced in the commercial satellite communications market.

Satellite imagery provider DigitalGlobe, meanwhile, is in the seventh year of a 10-year contract with the U.S. National Geospatial-Intelligence Agency to provide at least $300 million worth of imagery which complements imagery gathered by the intelligence community's own satellites. And due to its unclassified nature, the imagery can readily be shared with U.S. allies as well as relief organizations for natural disaster mitigation.

Commercial satellites also can play an important role as hosts for national security payloads, augmenting the Defense Department's own capabilities for a fraction of the cost of launching a dedicated mission. In one recent demonstration, a commercial communications satellite built by Orbital ATK played host to an experimental Air Force missile warning sensor. The U.S. Missile Defense Agency has also struck a deal to place kill assessment sensors aboard an unspecified commercial satellite system.

While all these developments provide reason for optimism, a sudden decline in the U.S. commercial space sector, as happened in the early 2000s in part due to U.S. space technology export policies, would put these technology and capability gains at risk.

Enhancing Resiliency in Space

The U.S. military and intelligence communities have long relied on their own satellites for services such as navigation and weapons guidance, imagery collection, missile warning and weather forecasting. But in a growing number of areas, notably communications and imagery, commercial capabilities have become a vital adjunct to the military's own assets.

This role has taken on elevated importance given emerging threats to U.S. government-owned space assets. Commercial systems capable of supporting national security requirements, either in concert with or in place of government assets, enhance the resilience and robustness of U.S. space capabilities, making the task of potential adversaries far more difficult.

Most of the same companies that manufacture national security satellites and components are also active in the commercial space sector. This generates economies of scale that allow the companies to keep prices for the government down and stay healthy when national security business is slow. At the same time, a thriving commercial space sector is a source of innovation that the government is increasingly seeking to leverage.

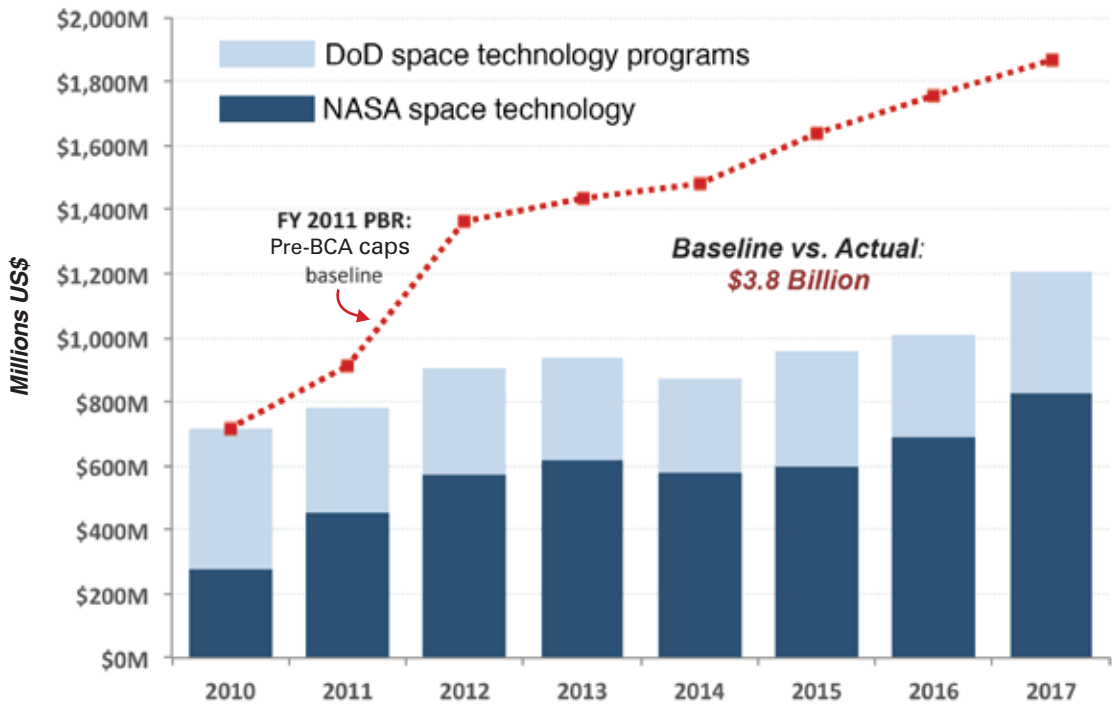
The military and intelligence communities have long recognized the benefits of having a vibrant commercial space sector and supported the revisions of the draconian satellite export control rules imposed in 1999. They did so because the loss of international market share by U.S. companies adversely impacted the space industrial base that the government depends on to provide national security satellites. Similarly, making the U.S. space companies able to compete more robustly, will benefit future national security systems.

Adequately Fund National Security and NASA Space Technology Investments

Although it may seem odd for a report on space industry competitiveness to make an argument for more government program funding, in fact, initial government funding of long term research and development was crucial to the emergence of commercial space activities and continues to be important today. At the start, military applications of rocket technology by governments led to the development of ballistic missiles, which later were developed by government into satellite launch vehicles. Similarly, initial government satellite programs investigated satellite technologies and validated the concept of geosynchronous telecommunications satellites and Earth imaging systems. Eventually, the commercial uses for launch services and satellites outstripped the demand by government—but the initial investment needed to take the requisite technologies to commercial fruition was made by the government—much as happened with the development of the Internet, digital computers and many aircraft technologies such as carbon fiber structures and jet engines.

Unfortunately, as shown in Figure 7, funding for space technology research and development has stagnated or fallen in recent years due to reductions in federal defense and civil space spending imposed by the Budget Control Act of 2011. Foreign competitors have not been similarly constrained and have been catching up even as U.S. technology development investment has faltered.

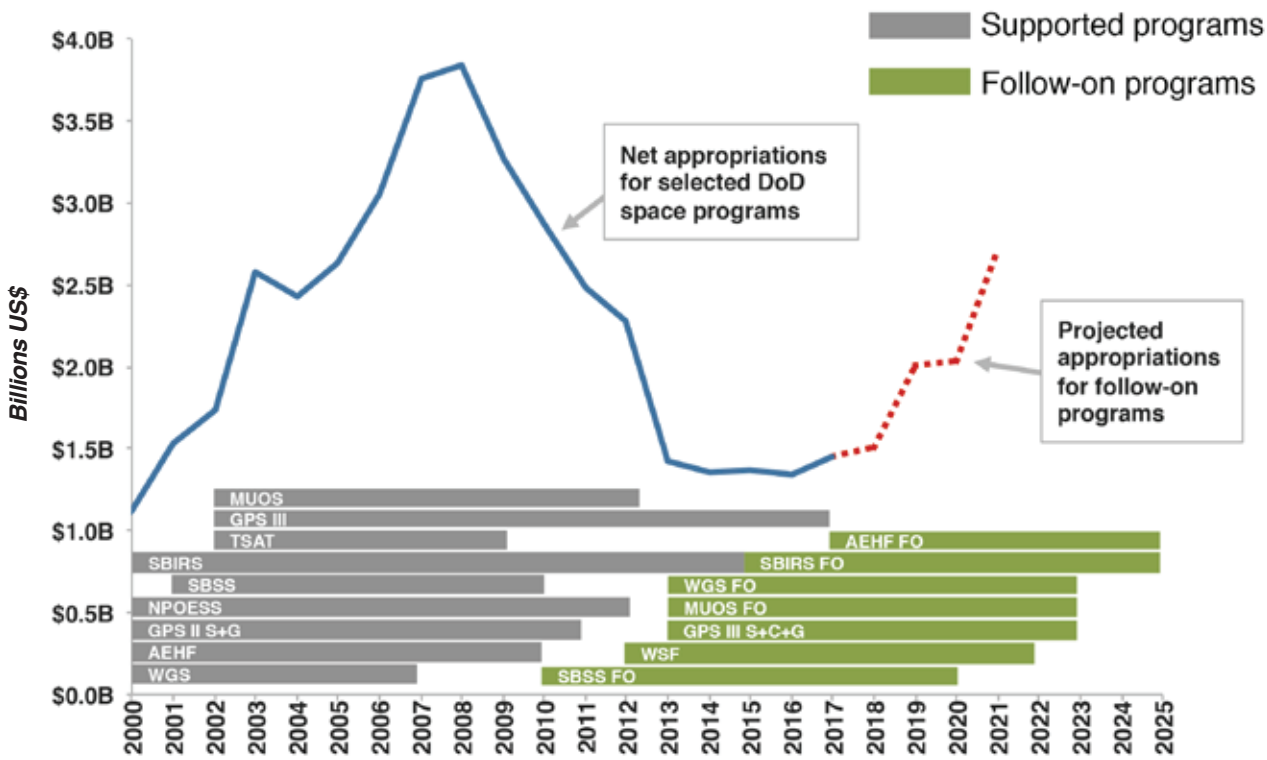
Figure 7: Budget Cuts Threaten U.S. Leadership in Space Technology. Source: AIA, based on data retrieved from the National Aeronautics and Space Administration, NASA Budget Estimates Book for Fiscal Years 2010-2017, and Department of Defense, Research Development, Test & Evaluation Programs Budget Appendix (R-1) for Fiscal Years 2000-2017. Source: AIA.



The Need for Continued National Security Space Systems Investment

While new private sector space activities offer new potential capabilities to support national security space, many can only be provided by dedicated national security space assets such as protected satellite telecommunications, Global Positioning System satellites, and missile launch detection. Current systems are aging and the investment to begin this decade-long process needs to begin. Unfortunately, due to the defense budget caps of the 2011 Budget Control Act and ongoing commitments, investment in this vital area, as shown in Figure 8, is lower than it has been in nearly 15 years. If our nation is to maintain its unique and asymmetric space enabled advantages—even as potential adversaries grow their capabilities and seek to put our assets at risk—increased investments in these vital mission areas must begin and continue for years to come.

Figure 8: Modernizing DoD's Space Architecture: Budget vs. Needs. Source: AIA, based on data retrieved from the Department of Defense, Research Development, Test & Evaluation Programs Budget Appendix (R-1) for Fiscal Years 2000-2017. Source: AIA.



Reaching New Heights: Policy Recommendations for Strengthening U.S. Space Competitiveness

It is in the economic and strategic interest of our nation to have and support a vibrant and, above all, competitive commercial space industry. Continued growth in the sector means more high-paying jobs, technological leadership, better productivity in industries that utilize space-derived data, and more revenue flowing into the economy.

To help maintain a strong U.S. commercial space industry, certain regulatory effects and challenges must be addressed. For example, the more favorable regulatory regimes of commercial entities in Europe, Asia and elsewhere are heightening competition by enabling those entities to develop world-class capabilities, in some cases with direct support from their governments. Meanwhile, the regulatory challenges the U.S. industry faces at home include burdensome export and operating restrictions, opaque and often unpredictable regulatory processes, and occasional reluctance on the part of government agencies to buy commercial services.

AIA has identified three major focus areas of policy recommendations that could enhance and strengthen the U.S. space sector and several specific recommendations in each area:

1. Level the Playing Field

Provide a responsive regulatory environment for commercial space activities. The list of commercial space activities is varied and growing, ranging from traditional applications such as satellite telecommunications to emerging ones like space resource utilization. At the same time, the U.S. space industry is governed by multiple federal agencies with disparate regulatory interests, including the Federal Communications Commission, the Federal Aviation Administration and Departments of State and Commerce. These agencies often suffer from funding and staffing shortages, a situation that creates bottlenecks in licensing processes and slows responsiveness to technological and market changes. The new Administration should work closely with Congress to ensure that the appropriate space regulatory agencies are fully resourced and staffed.

Continuously review, update and improve export rulemaking and policies to reflect market and technological evolution. Export reforms adopted in 2014 were necessary to give U.S. industry a fighting chance against increasingly capable and aggressive foreign competition, but fell short and more needs to be done. Many space systems widely available on the international market from countries (including close U.S. allies) remain on the USML and are thus subject to restrictions that historically have been applied in an arbitrary and capricious manner. Space tourism vehicles are similarly classified, and, given the additional constraints imposed by the MTCR, are effectively limited to operating inside U.S. territory, depriving companies of potentially attractive markets for their services. The process put in place to regularly review the export classification of space items, while laudable, has so far proven incapable of keeping pace with industry advances. The government should examine this process to identify and eliminate bottlenecks.

Restore full functionality to the Export Import Bank of the United States. The Export-Import Bank was created to foster exports of U.S. goods and services through government-backed low-interest loans to overseas buyers. More than 60 nations, including Britain, Canada, China France and Russia have similar agencies. In recent years, loans either provided or backed by these agencies have become a staple of international trade in satellites, satellite technologies, and launch services; many if not most deals now require such loans. Ex-Im support for the commercial space sector averaged $1 billion in 2013 and 2014. Due to Congressional politics, however, the bank effectively has been sidelined since July 2015 and prohibited from underwriting new loans. Given that Ex-Im's foreign counterparts remain very active in financing space deals, this exclusion amounts to unilateral disarmament in the global marketplace by our country. The new Administration should seek to insulate the Ex-Im Bank from politics and work with Congress to restore its ability to make loans large enough to support international space exports.

Ensure that tax reform supports U.S. space investment. Tax policies that benefit the U.S. space industry will pay large dividends for taxpayers by retaining jobs within the U.S., supporting national security, generating export revenues and enhancing competitiveness globally.

2. Expand Space Market Opportunities

Protect satellite spectrum. The frequency spectrum over which all radio signals travel is a congested resource, and in the digital age, there is increasing conflict as mobile wireless operators seek to expand their access, often time to the detriment of other services, including space and satellite communications. Yet, much of the data from satellite systems are the backbone of smartphone applications—weather, mapping, geolocation, etc. Recent International Telecommunications Union World Radiocommunication Conferences, a treaty-based international meeting of 190+ countries, have seen increasingly aggressive attempts by governments, including the U.S. led by the FCC, and wireless industry champions to constrain and restrict satellite use and growth, to expand terrestrial wireless access to frequencies already in use by satellite services.

Recent Federal Communications Commission (FCC) rulings also show a troubling trend toward disrupting globally harmonized satellite spectrum allocations, in favor of mobile wireless. The U.S. Government should strongly encourage a globally harmonized satellite spectrum policy, recognizing its importance through both the commercial and national space policy lens; it should work closely with its international counterparts for the most efficient and equitable allocation of this increasingly scarce resource, paying attention not only to current but also future satellite applications. In doing so, the government should always consider the potential importance of such policies on the U.S. space industry, whose services play a vital role in the economy, national security and public safety.

Preserve the orbital environment. The area where most space commerce takes place, near Earth orbit, is becoming increasingly congested. Orbital debris is becoming a significant problem, making space traffic management critically important. The danger was illustrated in 2009 when a commercial communications satellite collided with a spent Russian military satellite, creating thousands of pieces of dangerous orbital debris. To ensure a safe orbital environment, minimize the risk of debris-causing collisions, and provide certainty that satellites will be able to operate safely and profitably in the future, the government should continue to closely monitor the orbital environment and promote and incentivize efforts to minimize and even reduce the amount of hazardous debris.

Modernize US Missile Technology Control Regime (MTCR) restrictions to enable new, peaceful, international private sector space applications. Given new and emerging space systems, AIA recommends a thorough review of current U.S. MTCR rules. AIA believes that reasonable modifications to the existing rules could enable operations of U.S. commercial space vehicles at designated international spaceports that have proper technology security controls.

3. Prioritize Space Competitiveness as Vital to our Nation

Designate a senior U.S. government official as a commercial space advocate and make Space Competitiveness a priority for the National Space Council. Today, the government agencies involved in space activities advocate primarily on behalf of themselves in government-wide coordination and policymaking venues. The U.S. space industry currently has insufficient representation in these venues. Given that commercial space capabilities are closely intertwined with government activities, and given the strategic and economic importance of the sector, the Administration should appoint a dedicated senior official as the lead a commercial space advocate for the U.S. government. This position would manage interagency coordinating bodies, including a possible National Space Council chaired by the Vice President.

Leverage commercial capabilities to advance government missions. Agencies should, where possible, make use of expedited procurement rules for commercial space products and services and avoid developing systems and capabilities that are already available from the private sector. Although there will always be uniquely government missions for which

there is no commercial solution, many can be effectively performed or supplemented by commercial capabilities. The Trump Administration should emphasize that government agencies, including the Department of Defense, should utilize commercial space services to the maximum practical extent.

Encourage enhanced leadership role for the Commerce Department's International Trade Administration (ITA). ITA should play a greater role in fostering, promoting and advocating exports abroad for U.S. commercial space technologies and products. ITA can add value by developing measurable trade and export objectives to track progress. One specific idea would be to undertake a review of the organizational structure and effectiveness of the Commerce Department's Office of Space Commerce as it relates to ITA and the National Oceanic and Atmospheric Administration (NOAA), and develop recommendations for improvements. NOAA has been given the responsibility to license imagery satellite exports, but does not have the structure or resources to adequately advocate for the growing space sector. ITA could utilize its existing organization advocacy expertise to further promote the sector.

Identify space security cooperation as a priority. Allied investment in U.S. military space capabilities reduces costs, promotes interoperability and provides new markets for U.S. industry. An example is the U.S. Air Force's Wideband Global Satcom satellite communications system, where investments by close U.S. allies have expanded the size of the constellation while giving them global access. Increased space security cooperation can help to reduce the costs of procuring vital national security space systems while also strengthening the interoperability of US forces with our allies. The Defense Department should create an advocate for arrangements with allies similar to what is done with military aircraft within the office of the Air Force Executive Agent for Space.

The Office of Commercial Space Transportation (AST) should be adequately resourced to support a growing industry and moved out of the FAA but remain within the Department of Transportation. From a small operation licensing just a few launches annually at established launch ranges, AST's responsibilities have grown with the industry. Today AST is challenged to obtain the resources needed to support a growing number of launch service providers, space ports and even crewed re-entry systems. At the same time, the FAA is busy supporting a burgeoning air transportation system, implementing its Next Gen Air Traffic Control System and integrating drones into the national airspace. Moving AST out of FAA will bring greater visibility to the vital work it is doing which is essential to enable new space capabilities to be come into service in a timely manner.

We must continue to invest in national security space recapitalization. Although commercial space already benefits national security and can improve resiliency and reduce costs, we must not forget the need to continually modernize and recapitalize our dedicated national security space capabilities. Virtually every U.S. military operation today depends on space capabilities and many of these are supported by uniquely military systems. There is no commercial market for protected military satellite communications, national security surveillance capabilities and highly secure, jam-resistant global positioning. If we are to assure U.S. national success in military operations and deterrence, these continued governmental investments are essential.

National Security and civil space technology research and development need more investment

It has long been recognized that long term, high risk advanced technology research and development investments by the U.S. government have been key to the nation's leadership in many fields. Unfortunately, funding for space technology research and development has stagnated or fallen in recent years due to reductions in federal defense and civil space spending imposed by the Budget Control Act of 2011. AIA encourages the Administration and Congress to provide adequate resources to maintain leadership in these vital technologies.

Conclusion: The Road Ahead

A vibrant space industry is an important contributor to America's economy and national security. Its continued growth and promise will provide a magnet for the nation's engineering and entrepreneurial talent today, and for the next generation as well. As a facilitator of such talent, the space industry will help keep the nation on the cutting edge of technology and innovation, aiding economic progress and the missions of our national security and civil space agencies. The U.S. government can maximize success, both for new ventures in unproven markets and established companies in mature markets, by creating and maintaining a policy and regulatory environment that reflects a recognition of the space industry's value as a national asset.

The Aerospace Industries Association of America (AIA) is the premier trade association representing the nation's leading aerospace and defense manufacturers and suppliers and is the authoritative voice on issues of civil and commercial space, commercial aviation, defense and security and national airspace systems. For nearly 100 years, since the Association's founding in 1919 by many of aviation's early pioneers including Orville Wright, AIA has been the industry voice shaping the policies that matter most to our members. AIA's expertise represents the interests of manufacturers and suppliers of civil, military, and business aircraft, helicopters, unmanned aerial systems, space systems, aircraft engines, missiles, materiel, and related components, equipment, services, and information technology.

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