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MOORMAN CENTER FOR SPACE STUDIES

Leveraging Commercial Space Capabilities for U.S. National Security

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Executive Summary

The United States continues to debate how to improve the capability, affordability, agility, and resilience of its force structure and posture for national security space activities to address current and emerging threats to the freedom of space. Freedom of access to, passage through, and operations in space are now contested by nations with inimical interests and hostile intentions. China and Russia are undermining the rules-based international order in multiple domains. This includes testing and deploying an array of space and counterspace systems, including weapons in space, that threaten our national interests.

Concurrently, the availability of space goods and services in the international commercial marketplace has increased significantly with the growth of the private sector's investment in space. Long-standing national policy guidance directs that the U.S. Government (USG) shall (1) use commercial goods and services to the maximum extent practicable, except for national security, foreign policy, or public safety reasons, and (2) not compete with the commercial space sector.

The growth of commercial space activities creates significant opportunities that should be fully leveraged by the USG to enhance national security. It also poses challenges, however, that must be addressed to mitigate the risks of increasing the use of commercial capabilities for such purposes. A fundamental consideration for national security planners is the desired degree of reliance or dependence on commercial capabilities. Rigorous, objective, data-driven analytic decision support is essential to inform force design and acquisition decisions, including where commercial goods and services do or do not fit in national security space force structure and posture.

The National Security Space Association strongly urges that immediate attention be given to the following recommendations for how the USG can more effectively leverage the commercial space sector's investments, technology, know-how, goods, and services to enhance defense and intelligence space activities.

- The National Security Council and National Space Council should drive alignment of the federal departments' and agencies' roles as consumer, investor, and regulator of the commercial space sector as well as increase coherence across multiple government processes and implementation activities.
- The DoD and IC should continue to enhance collaboration and partnerships with the commercial space sector writ large. A much closer relationship between the national security space enterprise and the commercial space sector is needed. The cultural, organizational, information-sharing, and security barriers impeding enhanced collaboration and partnerships must be resolved.
- The President should promulgate more detailed policy guidance that directs U.S. national security space sector organizations to leverage commercial capabilities. The new policy should establish a framework for how the DoD and IC can seize the opportunities provided by the growth of commercial space investments and activities while acting to mitigate associated risks. The guidance should direct specific measures to better leverage commercial capabilities and offload commodity or other select missions, functions, or tasks in order to drive USG investments toward unique and advanced national security space capabilities that create strategic and operational advantages.
- The DoD and IC should determine whether and how to leverage commercial capabilities based on strategy, doctrine, mission, threat, risk and other factors that are part of the force design process. Mission, requirements, architecture, operations, and economic analyses should be conducted to help determine whether and how commercial space capabilities fit in the structure/posture for combat service support, selected combat support, and national intelligence missions, functions, and tasks. Rigorous, objective analyses are essential to enable the U.S. Space Command, U.S. Space Force and intelligence agencies to make well informed, evidence-based force design and architecture decisions.
- The DoD and IC must assess and fully understand the mission-critical dependencies, operational risks, vulnerabilities to threats, and policy implications that any reliance or dependence upon commercial space

goods and services would entail. Evaluation of potential uses of commercial space goods and services should be performed to determine their performance strengths and weaknesses and whether they will generate cost savings or avoidance, can accelerate capability delivery, or provide a new source of innovation or invention. The DoD and IC should use commercial space capabilities prudently and pragmatically where they can best satisfy selected combat service support, combat support, and national intelligence mission needs and requirements. Commercial capabilities should not be relied upon to execute combat missions, except in exigent or emergency circumstances.

- The Secretary of Defense and Director of National Intelligence should align authority, responsibility, accountability, and resources to enable the efficient acquisition of commercial space goods and services with discipline at the speed of relevance. This includes understanding the different kinds of business models and contractual arrangements that can be used under the Federal Acquisition Regulations Part 15 contracting, Civil Reserve Air Fleet (CRAF)-like arrangements, Indefeasible Rights of Use, service level agreements, leases, other forms of public-private partnerships, and government-owned and -controlled as well as contractor-owned and -controlled approaches.
- The Secretary of Defense and Director of National Intelligence should establish agile processes for the procurement of commercial goods and services and determine appropriate management and organizational alignment. Whatever approach is established to create a tailored interface mechanism and process between the national security and commercial space sectors, it must be chartered so as to ensure the USG is internally coordinated, a well informed and sophisticated consumer, and knowledgeable about commercial markets and business cases, foreign availability, technology state-of-the-art, best practices, and available sources of innovation and invention.
- The DoD and IC must take steps to improve their acquisition and contracting professionals' knowledge and experience to ensure the national security space enterprise is a well-informed consumer that appreciates the principle of *caveat emptor*. The DoD and IC should buy commercial goods and services as efficiently as possible by leveraging the USG's buying power for best value, buy commodities as inexpensively as possible, and avoid buying on the spot market unless necessary. Similarly, the DoD should explore outsourcing or selective privatization of selected functions and tasks such as spaceports and launch ranges, on-orbit servicing, spacecraft command and control, unprotected satellite communications, non-military positioning, navigation, and timing, and environmental monitoring.
- Similarly, the DoD and IC must take steps to ensure the national security space enterprise is an astute and discerning investor in commercial space capabilities. Such investments should be focused on creating strategic or operational advantages, sustaining special relationships, utilizing "real estate" for hosting payloads, increasing the number and sophistication of space domain awareness sensors, enhancing protection/resilience (beyond what's required for commercial activity) to enable military utility, and enabling game-changing, leading-edge, disruptive or unique capabilities. USG intervention in the commercial market should be avoided unless it is critical to national security.
- Finally, the USG must be a sensible and responsible regulator of the commercial space sector. The DoD and IC must protect their U.S. national security authorities and equities, including enhancing the commercial space sector's contribution to the strength and health of the U.S. space industrial and technology bases. U.S. regulators should "lean forward" to ensure America is the preferred location for firms to be licensed. Since U.S. competitiveness is a national security interest, encouraging the most competitive firms to be subject to U.S. jurisdiction and control is in the national interest. In this regard, the USG must take steps to help create a predictable, free, and fair international business and regulatory environment for the commercial space sector. Federal departments and agencies must collaborate to proactively support and advocate for U.S. companies in international competitions, identify and counter unfair and corrupt foreign practices, and work aggressively to shape international legal and regulatory regimes.

Introduction

The United States continues to debate how to improve the capability, affordability, agility, and resilience of its force structure and posture for national security space activities to address current and emerging threats to the freedom of space. Freedom of access to, passage through, and operations in space are now contested by nations with inimical interests and hostile intentions. China and Russia are undermining the rules-based international order in multiple domains. This includes testing and deploying an array of space and counterspace systems, including weapons in space, that threaten our national interests.

Concurrently, the availability of space goods and services in the international commercial marketplace has increased significantly with the growth of the private sector's investment in space. Long-standing national policy guidance directs that the U.S. Government (USG) shall (1) use commercial goods and services to the maximum extent practicable, except for national security, foreign policy, or public safety reasons, and (2) not compete with the commercial space sector.

The growth of commercial space activities creates significant opportunities that should be fully leveraged by the USG to enhance national security. It also poses challenges, however, that must be addressed to mitigate the risks of increasing the use of commercial capabilities for such purposes. A fundamental consideration for national security planners is the desired degree of reliance or dependence on commercial capabilities. Rigorous, objective, data-driven analytic decision support is essential to inform force design and acquisition decisions, including where commercial goods and services do or do not fit in national security space force structure and posture.

Taking this into account, the National Security Space Association strongly urges that immediate attention be given to the following analysis and recommendations for how the USG can more effectively leverage the commercial space sector's investments, technology, know-how, goods, and services to enhance defense and intelligence space activities.

Context

The global security environment is dynamic, uncertain, and increasingly dangerous. The United States confronts multiple rivals and adversaries around the world. The space domain is an extension of the ongoing geostrategic competition – and is an arena for political, economic, scientific, technological, and military dimensions of that competition. Indeed, the competition now encompasses the entire Earth-Moon system.

Critical U.S. space assets are being held at risk in this highly contested space operating environment. The pace, scope, and intensity of the threat (to, in, through, and from space) continue to increase as exemplified by China's and Russia's anti-satellite weapons tests and China's test of a hypersonic fractional orbital bombardment system. Moreover, the speed of

the threat is outpacing the USG's acquisition cycles and timelines. Peer competitors are fielding space weapons faster than the United States is acquiring capabilities to counter the threat.

The global diffusion of space technology and know-how has increased the foreign availability of certain space capabilities equivalent to or better than those produced by the United States. Consequently, allies and international partners have indigenous space capabilities to contribute to collective security as well as compete in the commercial space market. Many competitors' governments either directly or indirectly subsidize their space industry, with a permeable membrane between their public and private space sectors. In particular, China has an integrated national strategy of military-civil fusion.

Successive administrations of both political parties have stated that the United States has a vital national interest in assuring the unimpeded access to and use of space. America has leveraged its strategic advantages in space for prestige, influence, knowledge, wealth, power, and security. Space activities are integral to our way of life, economic well-being, and national security.

The USG thus recognizes the imperative to compete successfully, counter the threat, and sustain America's strategic advantages in space. Consequently, the growing threat is driving the national security space enterprise's efforts to evolve, adapt, and improve mission capabilities; enhance the speed and agility of capability delivery; increase the affordability of acquiring, operating, and sustaining capability; strengthen space mission assurance and resilience; and protect and defend space assets.

At the same time, the vibrancy of the commercial space sector has strengthened the U.S. space industrial and technology bases. Commercial space revenues are expected to grow from ~\$400 billion to over \$1 trillion in 10 years. The private sector is the leading investor in some key areas of space-related research and development (R&D).

Background

U.S. Government – Commercial Space Sector Interaction

The USG performs multiple concurrent roles vis-à-vis the commercial space sector as a consumer, investor, and regulator. The USG buys goods and services from the space industry. In economic terms, the federal space market is a monopsony with one buyer (i.e., the USG) and many suppliers. While the USG does not directly subsidize commercial space enterprises, it invests in the development of space goods by U.S. industry via contracted research and development or buying commercial services. The USG also regulates the commercial sector to ensure compliance with domestic and applicable international law as well as federal policies and regulations, among other things, to protect national security and promote public safety.

U.S. national policy defines “commercial” space as goods, services, or activities provided by private sector enterprises that:

- Bear a reasonable portion of investment risk and responsibility;
- Operate in accordance with typical market-based incentives for controlling cost and optimizing return on investment; and
- Have legal capacity to offer such goods or services to existing or potential nongovernmental customers.

The commercial space sector encompasses traditional, non-traditional, new entrant, and start-up businesses. These include publicly traded and privately-owned companies. All are commercial enterprises that create intellectual property, offer goods and services, and must generate profit to remain in business. Some companies exclusively or primarily compete in the international commercial market, some compete primarily in the U.S. federal market, and some compete in both markets. Moreover, some companies have business models that leverage federal business for their benefit in the commercial market, some leverage their commercial business for their benefit in the federal market, and some want as little to do with the USG as possible.

USG authorities and responsibilities for regulation of the commercial space sector are dispersed across multiple departments and agencies. The Department of Commerce regulates the export of dual (civilian and military) use space items, the operation of private remote sensing space systems (e.g., commercial imagery), and is responsible for basic space traffic management services to commercial space operators. The Department of Transportation regulates the commercial space transportation industry (i.e., launch and reentry operations). The Department of State regulates the commercial export of space and related defense articles and services. The Federal Communications Commission regulates commercial use of orbital slots and the radiofrequency spectrum. The DoD and IC are the largest USG consumers and investors in space capabilities. While they do not have direct responsibility for regulating the commercial space sector, they are involved in all interagency processes for such regulation. In addition, legislative authorities and responsibilities are dispersed across numerous Congressional oversight committees.

In general, U.S. policy objectives regarding the commercial space sector have been consistent across administrations of both parties. Fundamentally, these include USG support to enhance the international competitiveness of the U.S. space industry and utilizing commercial space goods and services as practicable, except for reasons of national security, foreign policy, or public safety. The number and type of USG statutes, policies, and regulations have expanded concurrently with the growth of commercial space activities. These include legislation such as the 2015 Commercial Space Act, Presidential and other executive department directives and instructions, as well as export and operating licenses.

Evolution of the Commercial Space Sector

The international commercial space market consists of segments including launch services, telecommunications, earth observation, navigation and such emerging segments as tourism, space situational awareness, and mining. During the early stages of the space age, space assets were exclusively owned and operated by governments. Satellite telecommunications were the initial space technology to be commercialized. President Kennedy signed the Communications Satellite Act of 1962 leading to the creation of the intergovernmental international satellite communications organization (INTELSAT) in 1964 and its full privatization in 2011. Spurred by global competition with the Soviet Union, U.S. industry held the leading position in the commercial space market with only limited foreign competition during the Cold War.

Successive U.S. administrations gave national policy impetus to encourage the growth of the commercial space sector. For example, Presidential Directive 37, “National Space Policy,” signed by President Carter in 1978, directed that “The United States shall encourage domestic commercial exploitation of space capabilities and systems for economic benefit and to promote the technological position of the United States, except that all United States earth-oriented remote sensing satellites will require United States Government authorization and supervision or regulation.”

In 1983, President Reagan issued an executive order that gave civilian access to the Global Positioning System’s (GPS) positioning, navigation, and timing signals on a continuous, worldwide basis, free-of-charge following the Soviet downing of Korean Airlines Flight 007. DoD set the GPS “Selective Availability” feature, that enabled DoD to reduce the accuracy of GPS signals, to zero in 2000 at President Clinton’s direction. Combined with subsequent decisions regarding commercial remote sensing, these actions enabled the rapid growth of GPS user equipment, geographic information systems, and myriad other commercial applications.

President Reagan took another major step enabling commercialization by issuing National Security Decision Directive 94, “Commercialization of Expendable Launch Vehicles” in 1983 which directed that the “U.S. Government fully endorses and will facilitate the commercialization of U.S. Expendable Launch Vehicles. The U.S. Government will license, supervise, and/or regulate U.S. commercial ELV operations only to the extent required to meet its national and international obligations and to ensure public safety.”

The United States led the international commercial market in launch services until displaced by France following its investments in Arianespace in the 1990s. With the end of the Cold War, the USG also modified national policy to allow Russia to launch U.S. satellites and components (in part to prevent the proliferation of Russian ballistic missile technology and know-how). It also negotiated commercial space launch trade agreements as well as technology security safeguards agreements with Russia, Ukraine, and China that enabled their entry into the launch services market. These non-market competitors created further displacements of U.S. commercial launch providers. SpaceX’s entry into the international

launch services market with reusable launch vehicles has helped return the U.S. to a leading international position in space launch.

During the post-Cold War period in the 1990s, exuberant forecasts of the commercial space sector's anticipated growth were driven by expectations of a large expansion of commercial satellite communications and remote sensing as well as the attendant increased demand for commercial launch services. Several companies had plans to operate large, proliferated constellations in low Earth orbit to deliver mobile satellite services. In addition, the USG facilitated the commercialization of satellite imagery technology with the Land Remote Sensing Act of 1992 and President Clinton's issuance of Presidential Decision Directive 23, "U.S. Policy on Foreign Access to Remote Sensing Space Capabilities", in 1994.

Unfortunately, the forecasted large growth of the commercial space market failed to materialize. In retrospect, it proved faster and less expensive to lay fiber optic cable and build out cellular networks than to go to space for information and communications networking (cell phones could operate indoors, whereas satellite phones could not). Many of the businesses pursuing the delivery of broadband communications from space (e.g., Iridium, Teledesic, Orbcomm, ICO Global Communications, and Globalstar) failed or were downscaled. In order to keep the Iridium constellation from having to be deorbited by Motorola, the USG stepped in and provided "pennies on the dollar" for a contract to use the system and approval of the company's "fire sale" from bankruptcy court.

Similarly, despite efforts to commercialize data collected by the USG's Landsat system and licensing the operation of high-resolution commercial imagery satellites, the commercial remote sensing market did not expand as expected in the 1990s. The first-generation systems either failed to reach orbit or the companies (e.g., Space Imaging, WorldView, Orbimage) could not capture as much of the aerial remote sensing market as they expected to be profitable and could not close their business cases, leading to consolidation in the market. Moreover, Russia, Canada, Italy, Germany and other countries followed the precedent established by France and the United States and sold high resolution electro-optical and synthetic aperture radar (SAR) commercial imagery adding to the competitive pressures. In fact, foreign competitors took the lead in commercial SAR imagery despite U.S. technical advantages.

Nonetheless, the series of aforementioned USG policy decisions laid the groundwork to both enable the commercialization of space technology and encourage the growth of the commercial space sector. What some observers are calling a "second space age" has emerged in the 21st century catalyzed by the global diffusion of space technology and know-how, numerous technological advances, the wealth generated by the information technology revolution, and the entrepreneurial space ambitions and competition among several "dot com" billionaires.

Today the international commercial space market is vibrant. In 2021, the commercial satellite industry had record growth in the number of satellites launched into orbit as well as capital investment in commercial space ventures. It generated nearly \$300 billion, while the

commercial launch services market grew to about \$5 billion. The commercial space sector is expected to continue to grow with rising demand for ubiquitous information and communications technology networking, information collection and data analytics, space situational awareness, and the emergence of space tourism, on-orbit manufacturing, servicing, and maintenance, and resource extraction.

Indeed, the volume and diversity of space activities occurring in the commercial sector is impressive. The number of new entrants continues to increase. Moreover, just ten years ago, many of the aforementioned space activities would not have been imaginable for the commercial sector to undertake. The USG, however, still is largely postured for the world that existed 10-15 years ago. It continues to be unprepared to take full advantage of the growth of privately-funded commercial space technology.

The commercial space sector is now leading the USG in key areas of space-related R&D. Private enterprises are investing, innovating, and inventing to advance the state of the art and bring new capabilities to market. The commercial space sector, as noted, not only has been fueled by the personal wealth, entrepreneurial spirit, and aspirations of billionaires, it is also attracting significant new capital investment from others because of the expected returns. Unfettered by the defense acquisition system and burdensome government requirements, private enterprises are speeding the development and incorporation of new technology into commercial space systems with novel design and manufacturing processes.

The U.S. National Security Space Enterprise's Experience with the Commercial Space Sector

The DoD and IC have extensive experience buying goods and services from the private space sector. They have effectively implemented national policy guidance and both supported and encouraged the growth of commercial space activities over many decades. However, their track record at leveraging the commercial space sector for U.S. national security is inconsistent. The need to balance competing objectives such as ensuring combat effectiveness in wartime, operations security of military forces, protecting intelligence sources and methods, enhancing the space industrial and technology bases, and indecision regarding how best to acquire and utilize commercial goods and services are contributing factors.

A brief synopsis of case studies regarding the national security space enterprise's experience with the most mature segments of the commercial space sector reflects significant and earnest efforts by the DoD and IC to leverage commercial space capabilities. DoD, for example, repeatedly studied whether it is more efficient to lease commercial satellite communications services versus own and operate military satellite communications systems. While it has continued to do both, DoD increasingly leased telecommunications services and often acquired surge capacity on the spot market when necessary as the capabilities and capacity of the commercial satellite communications industry evolved. (It should be noted that acquiring such services on the spot market has been shown to be inefficient and expensive.)

During the Persian Gulf wars and the Global War on Terrorism, for example, commercial services provided the majority of DoD's satellite communications capacity.

The evolution of space logistics reflects a similar trend. After the 1986 Space Shuttle *Challenger* launch disaster, DoD stopped relying on the Space Transportation System (Shuttle) to deliver national security payloads to orbit and returned to the use of expendable launch vehicles for this purpose. It subsequently initiated several modernization programs – e.g., Advanced Launch System (ALS), National Launch System (NLS), and Evolved Expendable Launch Vehicle (EELV) -- to achieve assured access to space. While the ALS and NLS programs failed to gain traction for various reasons, DoD was able to proceed with the EELV in part by working with the private sector to leverage the anticipated increase in launch rates in the commercial market to improve the EELV's affordability. More recently, DoD modified its procurement approach to acquire commercial launch services and set criteria to enable new entrants as well. Indeed, while DoD failed to follow through with its demand signal for small and medium class launches in the 1990s, it recently moved to expand the pool of potential commercial providers to deliver "tactically responsive" launch services.

The national security space enterprise's experience with commercial remote sensing has followed a comparable path. After blocking the commercialization of remote sensing technology primarily to retain national security advantages, DoD and the IC shifted their position once the Cold War ended in large part to help sustain the national reconnaissance industrial and technology bases when the national intelligence budget was significantly reduced in the 1990s. The National Imagery and Mapping Agency, later renamed the National Geospatial-Intelligence Agency, issued a series of contracts to acquire commercial imagery data and products, particularly for mapping, charting, and geodesy applications, and expanded sharing of unclassified imagery products with allies and partners.

This approach to the use of commercial imagery enabled the National Reconnaissance Office to focus on higher priority intelligence collection requirements and shift resources to develop more advanced capabilities for critical missions. Commercial imagery purchases helped the domestic industry to move forward, recapitalize its second generation systems, and hold their own against foreign government-subsidized competitors. During the Global War on Terror, the DoD and IC greatly increased their use of unclassified commercial imagery to share with coalition partners. The continued growth of the commercial remote sensing industry has prompted the USG to consider how to employ commercial imagery capabilities as part of a federated or hybrid geospatial intelligence architecture where a variety of considerations including timeliness and acuity come into play.

Despite USG policies to encourage and support commercial space activities, the private sector has been frustrated with the federal government. It has noted the difficulty of doing business with the USG, the slow pace of its regulatory, procurement, and contracting processes, the level of resources it has allocated to buy commercial space goods and services, and its disinclination to buy commercially available items. Moreover, commercial space companies have observed that the national security enterprise is an uneducated buyer and an unreliable

partner, sends mixed demand signals, and raises false expectations about the needed supply of certain products or services. The private sector also has remarked on the structural impediments to doing business with the DoD and IC such as the difficulty in obtaining security clearances and meeting unique security requirements. It is clear that there is an “impedance mismatch” between the public and private space sectors; the defense acquisition system and various incentives for government employees do not necessarily drive the DoD components and intelligence agencies to behaviors desired by the private sector.

Lessons Learned (or Observed) from Experience

Several lessons can be drawn from the national security space enterprise’s experience to date with the commercial space sector. First, it is very difficult for the USG to align its roles as consumer, investor, and regulator vis-à-vis the private sector. Inter-agency and inter-sector coordination and collaboration is challenging given the dispersion of authorities and responsibilities, the size, complexity, and number of actors, and different missions and objectives. Consequently, the national security space enterprise must engage its counterparts in the executive and legislative branches to foster alignment within the USG and consistency with the private sector to achieve national security objectives.

Second, globalization is impacting the international commercial space market and the economic competitiveness of the U.S. space industry. The number of competitors and globalization of the supply chain create new and challenging market dynamics. While most governments subsidize their commercial enterprises either directly or indirectly, some foreign governments also engage in economic espionage and corrupt practices to create unfair advantages to the detriment of the United States. The USG must better understand the international commercial marketplace and work more closely with the private sector to enhance its international competitiveness.

Third, with respect to its role as a consumer of commercial space goods and services, U.S. national security space organizations have both the policy guidance and regulatory flexibility to take full advantage of what the private sector can offer. The Federal Acquisition Regulations (FAR) fully enable procurement of commercial space goods and services. The FAR provides guidance and flexibility to buy and lease commercial capabilities. Moreover, there are a broad range of contracting mechanisms available to acquire such capabilities. Simply put, acquisition approach and contract type must be matched to mission need and capability. As the monopsonist (within the federal space market), the USG should be leveraging its buying power to obtain best value and satisfy national security requirements. While commodities should be bought as inexpensively as possible, the USG must also learn to accept and exploit what is commercially available.

At the same time, the USG must apply the basic rule of *caveat emptor* (buyer beware). It must be a well-informed consumer to make wise procurement decisions. The government must cultivate in-house intellectual capital to be a smart buyer. At a minimum, it must have expertise at the senior levels of the civil service workforce and not rely solely on Federally

Funded Research and Development Centers and Systems Engineering and Technical Assistance contractors. Changing personnel policies, divestment rules, and other actions should be considered so that experienced private sector officials can be brought into government for short periods of time. Moreover, the USG must strive to understand commercial businesses' motives, needs, timelines, and agendas. It is imperative that the USG apply this knowledge and exercise objectivity. It must base procurement decisions on facts, markets, and business plans - not "marketing" or the latest faddish ideas. This applies particularly to lease vs. own and make vs. buy decision calculus. Cost-benefit assessments for such decisions will depend on mission, requirements, costs, schedule, risks, and other factors. It will continue to be very expensive to lease surge communications capacity on the spot market -- an approach that creates vulnerability to supply disruption if the USG is unable to establish longer term quality-of-service arrangements for the supply of commercial space services. Dedicated commercial interfaces should be established to improve communication between the USG and commercial enterprises. Such mechanisms will facilitate socialization among the different cultures and lexicons and improve mutual understanding between the public and private space sectors.

Fourth, the national security space enterprise should collaborate with the private sector so that commercial companies are knowledgeable about its needs and requirements and invest to achieve specific desired and measurable defense or intelligence outcomes. This dialogue could also convey USG demand signals to influence commercial designs and investments. Furthermore, the USG should recognize that people innovate, not organizations. Innovation can and does occur within prime contractors as well as start-ups. The scale and age of organizations can impact how innovation is enabled and some organizational models make it easier than others for people to innovate. Mechanisms like the Defense Innovation Unit and Catalyst Campus are useful means of discovering and accessing innovation. While they have improved the USG's ability to scout talent, the scaling and "valley of death" challenges remain.

Advanced technology adoption also can be accelerated by fostering relationships between traditional suppliers and new entrants. Moreover, competition among traditional and non-traditional suppliers can be a useful tool to spur innovation and reduce price. Competition should be used wisely, however, where and when it makes sense. Competition is not always warranted. When not warranted, competition can be expensive, time-consuming, and counterproductive to accelerating acquisition speed.

Fifth, the USG must behave consistently and responsively to facilitate market predictability. It will remain challenging for the USG to balance competing interests and objectives including national security, foreign policy, economic competitiveness, and jobs. Space traffic management is a case in point since the absence of its provision by the USG is likely to adversely impact commercial space activities. Moreover, the USG must consider the risk of unintended domestic consequences in its policy, regulatory, and legislative decision making processes.

The breadth of national security equities – including strengthening the national security space industrial and technology bases – will not be properly considered if the DoD and IC do not

effectively engage and advocate in USG decision processes impacting the commercial sector (e.g., export, operating licenses, spectrum allocation, etc.). In doing so, the DoD and IC must recognize the dynamics impacting their ability to control the technology diffusion curve, especially the private sector's lead in certain R&D areas and increased foreign availability. Similarly, they must recognize that other nations without comparable regulations aim to shape the international legal and regulatory regimes to their advantage. Consequently, USG advocacy and support for U.S. companies is an important signal and tool in international competitions.

Observations on Leveraging Commercial Space Capabilities

The growth of commercial space activities creates significant opportunities that should be fully leveraged by the USG to enhance national security. These opportunities include promulgating new national security space acquisition practices and processes; accelerating capability delivery; accessing new sources of innovation and invention; using other peoples' money to save or avoid costs (e.g., by leveraging private investment in capability); establishing special industrial relationships; focusing USG investment on national security-unique and/or advanced capabilities; using competition as a catalyst for improved space capability, affordability, and agility; improving inter-sector relationships regarding resilience, protection, and defense of critical space missions and assets; and enhancing space mission resilience and the deterrence of aggression.

The growth of commercial space activities, however, also poses challenges that must be addressed to mitigate the risks of increasing the use of commercial capabilities for U.S. national security purposes. These challenges include USG understanding of commercial market segments, business cases, and companies; determining the proper role of commercial capabilities for national security; establishing relationships with businesses that have desirable capability but don't need federal funds to close their business case and don't want to be seen doing business with the DoD or IC; assuring the reliability and availability of commercial capabilities in crisis and conflict; and assuring the security, integrity, and continuity of commercial assets commensurate with national security mission needs and supported users.

The USG also must be prepared to address companies' expectations regarding USG quid pro quos and commitments. This includes some private enterprises' desire for USG anchor tenancy, advanced funding, liability indemnification, and compensation for war damages in consideration of the risks involved in allowing the USG to employ their capabilities for national security purposes. Furthermore, the USG must have realistic expectations regarding the commercial sector's contributions to cost savings or avoidance; resilience and deterrence; modifying the defense acquisition culture; and innovation and invention. Leveraging the commercial space sector more effectively should not be viewed as a panacea that will solve all of the national security space enterprise's force structure and posture challenges.

The USG must consider the operational utility of commercial space capabilities in the context of strategy, doctrine, and operations plans, the attendant national security space force structure and posture (e.g., size, capability mix, deployment location on-orbit, spectrum, and

geography) for conducting joint and combined military operations as well as intelligence activities, and the threat. (Joint operations involve only U.S. capabilities, while combined operations involve allied and international partners as well as U.S. capabilities.) A fundamental consideration for national security planners is the desired degree of reliance or dependence on commercial capabilities. This could range across the spectrum from deconfliction, coordination, and augmentation all the way to integration, federation, or perhaps even interdependence.

Rigorous, objective, data-driven analytic decision support is essential to inform force design and acquisition decisions, including where commercial goods and services do or do not fit in national security space force structure and posture. This requires highly competent, multi-disciplinary, system engineering, architecture, economic, and operational analyses. Systems architecture/constellation and spacecraft size/orbit, etc., are driven by mission, requirements, and the laws of physics and economics. In this context, the potential utility of commercial capabilities can be assessed without necessarily comparing them to existing requirements. The USG should examine what defense or intelligence needs could be aided or accomplished by facilitating standards as well as with different user practices.

National security space capabilities are employed to conduct combat, combat support, and combat service support as well as other national intelligence missions, functions, and tasks. Combat involves operations to influence the course and outcome of conflict (e.g., space control and space force projection). Combat support involves operations to improve the effectiveness of military forces as well as support other intelligence, civil, and commercial users (e.g., intelligence, surveillance and reconnaissance (ISR), space domain awareness (SDA), command, control, and communications (C3), positioning, navigation and timing (PNT), and environmental monitoring and weather forecasting (EM/WX). Combat service support involves operations to deploy and sustain military and intelligence systems in space (e.g., space logistics, spacecraft command and control, space servicing). National intelligence involves activities that support a range of users (e.g., national leadership, diplomatic, homeland security, economic) in addition to the military.

A classic design construct for military forces can be envisioned as a series of concentric circles. An inner ring of highly survivable/enduring capabilities, a middle ring of defended/protected capabilities, and an outer ring of secure but less protected capabilities. With respect to space forces, the inner ring should be comprised of the network of capabilities required to ensure the nation's survival under the most stressing wartime circumstances. The middle ring would comprise capabilities required to fight and win wars. The outer ring should be comprised of capabilities required to conduct daily operations other than war.

Such concentric circles for space force structure design are not intended to be synonymous with combat, combat support, and combat service support. Rather, there would be selective overlap between the middle and outer rings. In this construct, commercial goods and services could be utilized to perform selected combat service support and perhaps certain combat support missions, functions, and tasks. (It must be recognized of course that commercial assets employed by U.S., allied, or coalition operational forces may make them

legitimate military targets to an enemy.) Operational utility considerations such as mission need and requirements, performance, cost, schedule, and risk, and especially mission criticality, survivability, assuredness, resilience, integrity, reliability, robustness, endurance, and operational continuity, must be among the key determinants of whether and, if so, what commercial capabilities could be utilized in such roles. The bottom line is the USG should take a prudent and pragmatic approach that uses the “right tool for the job” whether that is a dedicated national security or commercial capability.

Given the current and emerging threat, mission survivability, resilience, and operational continuity both for deterrence (by denial and punishment) and warfighting must be key considerations in the design of the future national security space force structure. In this regard, it must be emphasized that many commercial assets are not designed to operate in operationally contested, limited, or degraded conditions; instead, they are designed to meet the needs of consumers of commercial space goods and services in a benign operating domain. Commercial satellite systems typically are designed only with sufficient mission assurance and resilience features to withstand the environmental phenomena and natural hazards of outer space. They may also have security features to protect against insider threats and cyber intrusion by hackers below the level of nation-states as well as other protection measures to assure positive command and control and system integrity to obtain the necessary return on investment. But their business plans do not include paying to field countermeasures to the array of threats necessary to be employed to conduct combat operations. The USG, however, could either incentivize the design of more resilient commercial capabilities or buy standard commercial goods and then pay for “after-sale modifications”.

Use of commercial space capabilities to increase the number of targets an adversary must engage may contribute to resilience if it moves the cost-exchange ratio in favor of the defender. Similarly, use of commercial space assets to increase national security capacity and robustness may contribute to endurance if the additional resource can be dynamically managed and employed when and as necessary. Clever use of commercial space capabilities thus may complicate an adversary’s risk calculus and contribute to deterrence, depending on the adversary’s mindset, risk taking propensity, sensitivity to international opprobrium, or concern for expanding the parties involved in a potential conflict. Indeed, such clever use of commercial space capabilities may increase the complexity of adversary targeting and thereby also contribute to deterrence, depending on the adversary’s space object surveillance and identification capabilities, counterspace weapons systems, and sensitivity to targeting non-dedicated military targets.

As the national security space enterprise redesigns its force structure and posture to counter the threat, it must adjust its acquisition and associated security policies and practices. (For numerous actionable recommendations in these areas, see NSSA, *“Acquiring Space Capabilities with Agility and Discipline at the Speed of Relevance”*, June 2020, and NSSA, *“Establish Governance and Align Security Policies and Programs to Enable U.S. National Security Space Missions”*, October 2020.) The DoD and IC should reevaluate how to buy space goods and services (whether from traditional aerospace and defense firms or new commercial

enterprises) to increase the speed and agility of capability delivery in order to turn inside or at least at pace with the threat. This includes leveraging digital design and engineering throughout the manufacturing process while moving to a zero-trust software and architecture environment to counter the cyber threat and supply chain operations. Production rates can be tuned, product improvement intervals pre-planned, technology inserted more frequently, and replenishment cadence changed by shifting to a combination of launch-on-schedule and launch-on-need), among other things, to increase efficiency, reduce costs, and take the risk of warfighting attrition into account in provisioning the force. Similarly, the DoD and IC must continue to adapt to the private sector's lead in key aspects of technology R&D and shift the space acquisition culture from risk aversion towards risk management.

In addition, the national security space enterprise should carefully reevaluate what to buy. This is not simply an issue for acquisition professionals; it also is an issue for the policy, requirements generation and validation, resource allocation, and operations communities. The international security environment is radically different today than it was 25 or even 10 years ago. Serious consideration must be given to the extent of operational performance and warfighting advantage necessary for mission success under contested, degraded, and operationally limited conditions against nuclear-armed powers. This will help to determine whether dedicated national security or commercial capabilities are required. Warfighting demands including attrition must be factored into planned and programmed constellation size and the required amount of deployed or stored (on-orbit or on the ground) mission capability.

Similarly, the national security space enterprise should reevaluate which organizations should be responsible for buying commercial capabilities. There are a plethora of DoD and IC space organizations that could buy commercial goods or services. In this regard, consideration should be given whether to consolidate or streamline the number of acquisition organizations to increase efficiency. The DoD and IC should determine and oversee the appropriate roles and responsibilities for commercial space acquisition among the U.S. Space Force Space Systems Command, the Space Development Agency, the National Reconnaissance Office, and other organizations.

Recommendations

The imperative to address the current and emerging threats remains an urgent matter that requires the national security space enterprise to adjust its force structure and posture and buying habits. The commercial space sector is vibrant, growing, and leading the USG in certain areas of space R&D. Consequently, the USG should determine how to more effectively leverage the commercial space sector's investments, technology, know-how, goods, and services to enhance defense and intelligence space capabilities.

The national security space enterprise must evaluate how best to utilize commercial practices, products, or services and modify the way it does business to acquire capabilities with agility and discipline at the speed of relevance. The following recommendations summarize a

focused approach and a set of actions the national security space community should implement to better leverage commercial space capabilities for U.S. national security.

- The National Security Council and National Space Council should drive alignment of the federal departments' and agencies' roles as consumer, investor, and regulator of the commercial space sector as well as increase coherence across multiple government processes and implementation actions.
- The DoD and IC should continue to enhance collaboration and partnerships with the commercial space sector writ large. The private sector is not a monolith – it is a dynamic and fluid mix of enterprises with a range of business models, products, and services. A much closer relationship between the national security space enterprise and the commercial space sector is needed as part of a whole of nation approach to address the complex space security challenge. Useful approaches include the U.S. Space Command's Commercial Cell, the IC Commercial Space Partners Forum, and personnel exchanges. Moreover, enhanced collaboration and partnerships will continue to be impeded unless cultural, organizational, information-sharing, and security barriers are addressed and resolved.
- The President should promulgate more detailed policy guidance to direct national security space sector efforts to leverage commercial capabilities. The new policy should establish a framework for how the DoD and IC can seize the opportunities provided by the growth of commercial space investments and activities while acting to mitigate associated risks. In particular, the guidance should direct specific measures regarding force design to better leverage commercial capabilities and offload commodity or other selected missions, functions, or tasks in order to drive USG investments toward unique and advanced national security space capabilities that create strategic and operational advantages. It should also encourage and promote the establishment of special relationships between the USG national security space enterprise and private sector companies. The National Space Council and National Security Council should establish a mechanism to oversee implementation of this policy guidance.
- The DoD and IC should determine whether and how to leverage commercial capabilities based on strategy, doctrine, mission, risk, and other factors that are part of the force design process. Mission, requirements, architecture, operations, and economic analyses should be conducted to help determine whether and how commercial capabilities fit in the structure/posture for space combat service support, selected space combat service, and national intelligence missions, functions, and tasks. Such rigorous, objective analyses are essential to enable the U.S. Space Command, U.S. Space Force, and intelligence agencies to make well informed, evidence-based force design and architecture decisions. They will also help weed out marketing, power point engineering, and fads to determine which commercial capabilities can contribute to improved operational efficiency, effectiveness, mission assurance/resilience, and deterrence. The analytic results should be shared with the Congress and U.S. space industry. Based on rigorous and objective force design

analyses, the DoD and IC should develop roadmaps that tie the current and desired operational and systems architectures together, identify capability gaps and shortfalls, and prioritize solutions. In addition, the DoD and IC should significantly expand experimentation with commercial offerings to determine if they can improve the effectiveness of military operations and intelligence activities. In this regard, funds should be made available to combatant commands (especially U.S. Space Command) to experiment and exercise with commercial space capabilities.

- The DoD and IC must assess and fully understand the mission-critical dependencies, operational risks, vulnerabilities to threats, and policy implications that any reliance or dependence upon commercial space goods and services would entail. Evaluation of potential uses of commercial space goods and services should be performed to determine their performance strengths and weaknesses and whether they will generate cost savings or avoidance, can accelerate capability delivery, or provide a new source of innovation or invention. The DoD and IC should use commercial space capabilities prudently and pragmatically where they can best satisfy selected combat service support (e.g., logistics) and combat support (e.g., ISR, SDA) mission needs and requirements. Commercial space capabilities should not be relied upon to execute combat missions except in exigent or emergency circumstances.
- The Secretary of Defense and Director of National Intelligence should align authority, responsibility, accountability, and resources to enable the efficient acquisition of commercial space goods and services with discipline at the speed of relevance. A subset of national security space acquisition professionals should be assigned to exchange programs with private space enterprises and receive training on how to acquire commercial goods and services. This includes understanding the different kinds of business models and contractual arrangements that can be used under the Federal Acquisition Regulations Part 15 contracting, Civil Reserve Air Fleet (CRAF)-like arrangements, Indefeasible Rights of Use, service level agreements, leases, other forms of public-private partnerships, and government-owned and -controlled as well as contractor-owned and -controlled approaches.
- The Secretary of Defense and Director of National Intelligence should establish agile processes for the procurement of commercial goods and services and determine appropriate management and organizational alignment. For example, should such acquisitions be done by mission or by setting up a commercial-focused program office? Should the organizational approach be internal to a single center or distributed across all/multiple centers? Whatever approach is established to create a tailored interface mechanism and process between the national security and commercial space sectors, it must be chartered so as to ensure the USG is internally coordinated, a well informed and sophisticated consumer, knowledgeable about commercial markets and business cases, foreign availability, technology state-of-the-art, best practices, and available sources of innovation and invention.

- The DoD and IC must take steps to improve their acquisition and contracting professionals' knowledge and experience to ensure the national security space enterprise is a well-informed consumer that appreciates the principle of *caveat emptor*. The DoD and IC should buy commercial goods and services as efficiently as possible by leveraging the USG's buying power for best value, buy commodities as inexpensively as possible, and avoid buying on the spot market unless necessary. They should create sustainable relationships for commercial services, as appropriate, through quality-of-service contracts both for efficiency and to preclude an adversary having the option of capability denial by buying up those commercial services in the international market. In addition, the DoD and IC should adopt the approach when uncertain of "buy a little, try a little." In this regard, the DoD should seek legislation that provides the Combatant Commands with a funding line for robust experimentation with commercial space capabilities. Similarly, the DoD should explore outsourcing or selective privatization of such selected functions and tasks as spaceports and launch ranges, on-orbit servicing, spacecraft command and control, unprotected satellite communications, non-military positioning, navigation, and timing, and environmental monitoring.
- Similarly, the DoD and IC must take steps to ensure the national security space enterprise is an astute and discerning investor in commercial space capabilities. Their investments should be focused on creating strategic or operational advantages, sustaining special relationships, utilizing "real estate" for hosting payloads, increasing the number and sophistication of space domain awareness/threat warning/attack reporting sensors, enhancing protection/resilience (beyond what's required for commercial activity) to enable military utility, and enabling game-changing, leading-edge, disruptive or unique capabilities. In particular, the DoD and IC must be pragmatic, avoid excessive over-exuberance or theology (e.g., one size fits all architecture type/spacecraft size/orbit). It must be recognized that not all start-ups will be able to compete effectively in the international commercial market. USG intervention in the commercial market should be avoided unless it is critical to national security. The DoD and IC should utilize cooperative R&D arrangements (e.g., CRADAs) to incentivize private sector co-investment. They should also explore formal mobilization, augmentation, and federation arrangements, including use of a CRAF-like model and novel collaborative information collection and/or analysis for space domain awareness and intelligence missions. The USG can also facilitate the maturation of new commercial businesses by leveraging its position as a monopsonist to incentivize desired behaviors among industry tiers and types of companies. This includes enhancing collaboration with incumbents and accelerators to facilitate bringing new technology from non-traditional companies and new entrants into programs as soon as practicable.
- Finally, the USG must be a sensible and responsible regulator of the commercial space sector. The DoD and IC must of course protect their U.S. national security authorities and equities, including enhancing the commercial space sector's contribution to the strength and health of the U.S. space industrial and technology bases. U.S. regulators should "lean forward" to ensure America is the preferred location for firms to be licensed. Since U.S. competitiveness is a national security interest, encouraging the most competitive firms to

be subject to U.S. jurisdiction and control is in the national interest. In this regard, the USG must take steps to help create a predictable, free, and fair international business and regulatory environment for the commercial space sector. Federal departments and agencies must collaborate as part of a whole of government effort, recognizing the commercial sector's value and role in the geopolitical competition, to proactively support and advocate for U.S. companies in international competitions, identify and counter unfair and corrupt foreign practices, and work aggressively to shape the international legal and regulatory regimes. This includes supporting efforts to define and promote responsible operations behaviors in space that will enable indications, warning, and response to hostile acts or demonstrations of hostile intent as well as sustaining the space environment.

NSSA is the only U.S. trade association dedicated solely to promoting the health and vitality of the U.S. national security space enterprise (Title 10 and Title 50) and its supporting industry partners. For more information, including how to join the Association, please visit us at www.nssaspace.org

We thank you and our valued members for your continued support of the NSSA, and the preservation and protection of the national security space community.



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