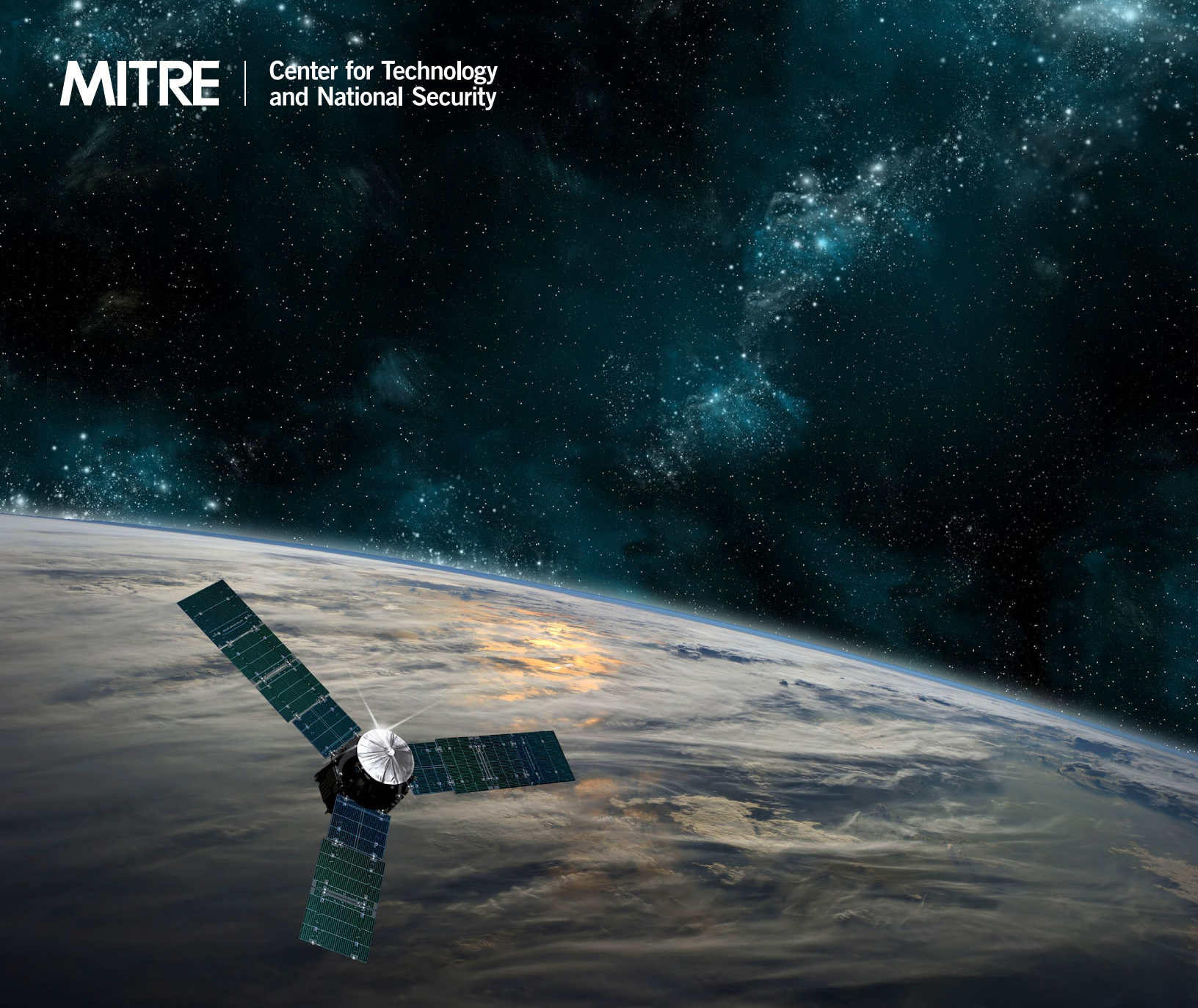


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A LOOK AT COMMERCIAL GEOSPATIAL INTELLIGENCE

by Renee Dauerer, Jenny Irvine, Mark Phillips, and Philip Tsang

OCTOBER 2020

Abstract

MITRE's Intelligence Advisory Board recommended that MITRE assess the commercial Geospatial Intelligence (GEOINT) landscape and provide recommendations for U.S. government investment and actions the U.S. government can take in partnerships within the commercial GEOINT market. Through a quantitative and qualitative assessment of the market, GEOINT policies, and observations of U.S. government use of commercial GEOINT, the authors identified numerous obstacles and challenges for the GEOINT industry and outlined four recommendations for U.S. government action to improve U.S. partnerships. Although primarily focused on the Department of Defense and the Intelligence Community, the recommendations apply across any U.S. government department that uses GEOINT extensively.

Given the current great power competition and global economy, action is imperative now to prevent the United States from falling behind and to improve and ultimately maintain the U.S. position as the world leader in GEOINT products and services. Doing so will enable the U.S. government to apply commercial GEOINT to its various missions, increase resiliency and diversity of GEOINT sources, and gain an information advantage against foreign adversaries.

“Damn it!” The Commander of the Joint Special Operations Task Force, operating off the coast of Africa, threw his tablet across the room. He was about to launch SEALs into hostile territory on a reconnaissance mission and had no recent national GEOINT, and the U.S. commercial GEOINT he could purchase was not up to mission requirements.

“Lieutenant, take my charge card and go across the compound to the Israelis and buy whatever GEOINT they have of the target area. Take an analyst with you to make sure you get what we need and then get back here ASAP.”

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Introduction

Geospatial Intelligence (GEOINT) is defined by the law in Title 10 of the U.S. Code, Section 467 (2005) as

the exploitation and analysis of imagery and geospatial information to describe, assess, and visually depict physical features and geographically referenced activities on the earth. Geospatial intelligence consists of imagery, imagery intelligence, and geospatial information.¹

While the above definition refers to government-controlled means and methods, the term “commercial GEOINT” is increasingly gaining traction as private industry continues to deliver GEOINT products and services.

Once the domain of non-descript governmental buildings and organizations, commercial GEOINT is becoming more widely available in the commercial market. Fueled by the demands of private-sector applications and enabled by unprecedented advances in technology and computing power, commercial industry has made impressive strides in GEOINT remote sensing and processing. Couple these factors with competitive drivers, true agile development processes, and the thrill of being on the cusp of technological advances, and the traditional GEOINT landscape has flipped. We are living in a world where the best and most advanced breakthroughs in imagery and analysis are coming from government and industry alike.

Commercial GEOINT supply is growing domestically and internationally. Foreign investment and partnership is helping to strengthen foreign capabilities, in some cases outpacing those of the United States. One notable area is that of Synthetic

Aperture Radar, or SAR, which is an all-weather, day-night capability with the ability to penetrate persistent cloud cover areas of the world.

These systems can detect changes due to natural disasters like floods and hurricanes or manmade activity like car tracks in the desert, new construction, and ships in the open ocean.

The high-resolution commercial SAR market began in 2007 after the launch of the German TerraSAR-X and the Italian Cosmo SkyMed, which introduced radar resolutions in the sub-meter range to the public marketplace.

Since then, foreign commercial SAR has grown to 15 satellites currently on orbit and more planned in the near future, while there is only a single domestic SAR provider on orbit and only a few more in the launch pipeline.

The reason for this imbalance is simple. Prior to October 2015, the U.S. licensing policy implemented strict controls on the operation and dissemination of SAR systems and data to commercial customers, particularly with regard to handling the information most valuable for advanced imagery interpretation and exploitation. In addition, U.S. commercial remote sensing policy

ONCE THE DOMAIN OF NON-DESCRIPT GOVERNMENTAL BUILDINGS AND ORGANIZATIONS, COMMERCIAL GEOINT IS BECOMING MORE WIDELY AVAILABLE IN THE COMMERCIAL MARKET.

¹ National System for Geospatial Intelligence, “Geospatial Intelligence (GEOINT) Basic Doctrine” Publication 1.0, April 2018.

limited SAR resolution to one meter, while foreign competitors—not bounded by similar governmental restrictions—provided sub-meter resolution, which allowed visibility of small objects and changes and thus broader usage. For example, in 1998, a U.S. company obtained a license to operate a one meter resolution SAR satellite but could not sell data better than five meters, and again in 2000, the government granted a one meter resolution radar imaging license, but any imagery sold was not authorized to be better than three meter resolution.² In October 2015, XpressSAR Inc. received a National Oceanic and Atmospheric Administration (NOAA) license to operate a SAR satellite constellation capable of collecting imagery better than one meter resolution, opening the door for domestic competition.³ Commercial SAR serves as a cautionary tale as to how strict policy creation can significantly hinder the innovation and technological advancements of an industry.

Since the early launches of trend-setters like IKONOS and TerraSAR-X, the U.S. government has assessed the risks versus opportunities, the costs versus returns, and the security implications versus mission impact of engaging with commercial GEOINT developers and suppliers. In 2002, the National Imagery and Mapping Agency (the predecessor to the National Geospatial-Intelligence Agency [NGA]) awarded the first commercial imagery contracts, called ClearView, and in 2003, President Bush signed National Security Presidential Directive (NSPD)-27 signaling the nation's commitment to maintain leadership in remote sensing space activities and the remote sensing industry. These early actions sought

to propel the remote sensing industry forward and apply commercial imagery to broad Department of Defense (DoD) and Intelligence Community (IC) missions, encouraging the use of commercial first and building national capability only for what could not be met with commercial capabilities. Despite these actions, commercial imagery adoption was slow and hindered by a difficult remote sensing licensing process. In turn this limited U.S. remote sensing innovation, reduced domestic investment, and stymied commercial imagery utility. As commercial GEOINT analytics have come to the market, they too have been slow for adoption by the IC and DoD, with mostly small research and development efforts and no established long-term operational contracts.

Today, with an increasingly interconnected worldwide economic market and geospatial data integrated into all aspects of everyday life, there is a tremendous growth opportunity for cooperation between the U.S. government and commercial GEOINT providers. This opportunity comes at a turning point of increasing foreign threats and continuous intelligence competition with great power rivals China and Russia, as well as regional belligerents North Korea and Iran. The National Security Strategy speaks to the urgency with which the United States must address the challenges these nations present.

This environment requires that the U.S. government help the home-grown commercial sector gain market leadership and control the standards, use of, and influence on the GEOINT value chain so that the market is not controlled by or influenced by foreign

² Weber, R. & O'Connell, K., "Alternative futures: United States commercial satellite imagery in 2020", Innovative Analytics and Training LLC, November 2011. [Online]. Available: <https://nsarchive2.gwu.edu/NSAEBB/NSAEBB404/docs/37.pdf> [Accessed: Aug. 21, 2020].

³ Foust, J., "XpressSAR receives NOAA remote sensing license", Space News, November 9, 2015. [Online]. Available: <https://spacenews.com/xpresssar-receives-noaa-remote-sensing-license/> [Accessed: Aug. 21, 2020].

adversaries. Challenges posed by policy, regulation, and decreasing budgets must be addressed quickly to fully harness the tremendous talent, drive, and innovative spark within the United States. This is especially important as rival powers rush to make conditions favorable for their own advantage. Given the opportunity through investment and leadership positions, foreign commercial entities could dominate the GEOINT supply chain, influence GEOINT standards for their own advantages by leading standards organizations, and even resort to predatory pricing, wiping out the U.S. commercial GEOINT industry. It would impact the trust in and accuracy of GEOINT if the majority of open source intelligence came from Chinese state-funded commercial providers who might modify the data or standards to meet their priorities versus common benefits for the rest of the world.

Fortunately, as recently stated by the Director of the Office of Space Commerce Kevin O’Connell, “America is the hub of technology and business innovation. This is one of our nation’s greatest strengths. . . . [U.S.] Government is responsible for the economic environment that is conducive to innovation and expansion.”⁴ Competition, innovation, and the ability to stretch boundaries within a free market will allow the commercial GEOINT industry to prosper.

This paper provides background on the overall commercial GEOINT landscape, assesses the opportunities for application of commercial GEOINT against a variety of missions, encourages collaboration and competition, and suggests actions senior government leaders can take to invigorate the industry. The intent is to spark innovation and chart a future for ensured U.S. industry leadership.

⁴ Remarks of Kevin M. O’Connell, Director, Office of Space Commerce, U.S. Chamber of Commerce 2nd Annual Space Summit Tuesday December 3, 2019, U.S. Chamber of Commerce, Washington, D.C.

Market Trends

To understand where and how to best leverage commercial GEOINT to improve U.S. capabilities, we must first understand the overall commercial GEOINT marketplace. Over the last several years, this marketplace has seen several trends in commercial GEOINT imagery, data, and services across the globe. Commercial companies are building on their experiences with traditional space platforms and sensors and developing new capabilities such as hybrid satellite constellations with electro-optical, SAR, Radio Frequency (RF), Automated Identification System (AIS), hyperspectral (HSI), and other sensor types, either on a single satellite or with multiple satellites working collaboratively. These hybrids deliver

combinations of imagery and insights against locations or objects of interest by combining the imagery with other GEOINT inputs. These same commercial constellations are moving toward high revisit rates and near 24/7 persistence for key geographic areas of interest to DoD and the IC. Steadily, technological advances are driving the commercial marketplace toward faster revisit rates, which benefit both government and private-sector demand.

Looking at the growth in commercial imagery provides a sampling of the overall growth in the commercial GEOINT market. Figure 1 shows domestic and foreign commercial imagery evolution, including plans

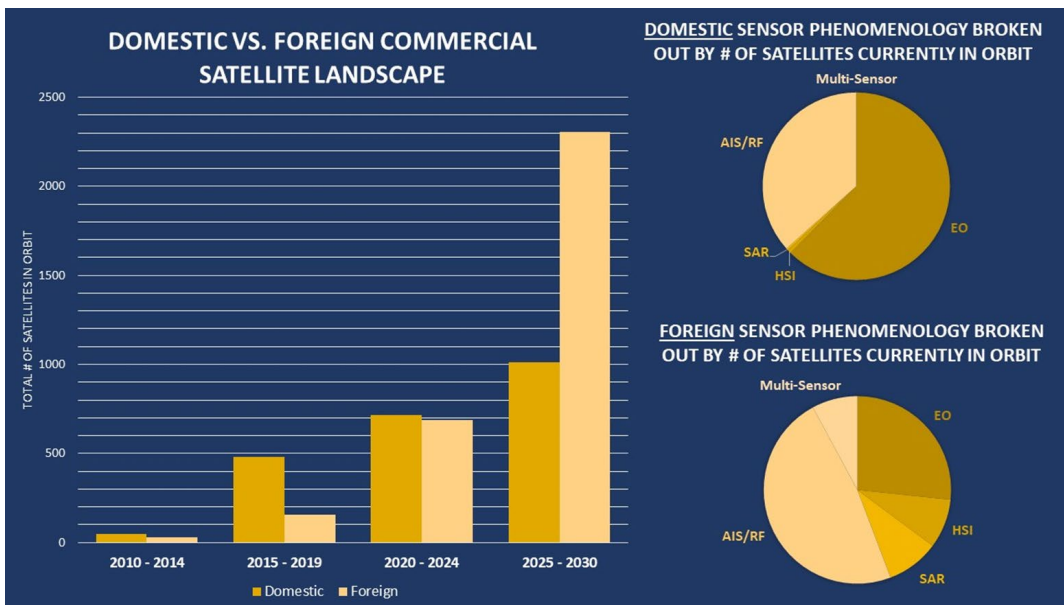


FIGURE 1. DOMESTIC VS. FOREIGN COMMERCIAL SATELLITE LANDSCAPE⁵

⁵ This figure summarizes findings from open source data that MITRE gathered and structured for NGA Source Commercial & Business Operations on commercial constellation providers and commercial geospatial analytics suppliers. This information includes both objective and subjective data points to characterize the marketplace maintained in a series of databases.

for future launches, and the breakdown of satellite phenomenologies onboard domestic and foreign systems. One should note a few takeaways from this chart:

- U.S. commercial imagery companies have focused largely on electro optical (EO) and AIS systems and lack the diversity of sensors present in foreign systems. One should not attribute this lack of diversity solely to the large number of Planet Dove (EO) and Spire Lemur (AIS/RF) satellites alone. Currently on orbit, there are only one domestic SAR satellite (Capella), two HSI satellites (Teledyne Brown and Orbital Sidekick), and no multi-sensor satellites. In contrast, foreign commercial companies have launched 15 SAR satellites, 14 HSI satellites, and 13 multi-sensor satellites.
- The combined foreign market has plans to surpass the U.S. commercial imagery supplier base within the next 10 years. Foreign investments, often backed by their governments, are allowing the foreign commercial imagery market to increase new technologies and make larger shifts among major capabilities versus the incremental changes U.S. companies often face.

The U.S. markets seem largely focused on building up core stand-alone technologies (EO, SAR, AIS), while the foreign markets are expanding into hybrid technologies and ever-larger constellations. This may be to the current advantage of the U.S. government, which often acts as the integrator for information

across different systems. However, as commercial analytics grow, the desire for more coordinated imagery and derived analytics should encourage the use of hybrid systems to meet needs more efficiently. Therefore, the U.S. government should consider the long-term opportunities and increase investment in these capabilities.

Riding atop the vast and dynamic commercial imagery market, the geospatial analytics domain is experiencing its own trends in innovation. Advances in data processing allow companies to deliver new change detection, activity trending, and analytics-as-a-service products to their customers. MITRE's analysis shows the commercial GEOINT analytics market shifting toward custom products—as companies move toward greater analytic capabilities, they tailor the product for specific users. By increasing advertisement of the U.S. government analytic needs, companies will respond with tailored products and services ensuring mission applicability. Additionally, investment in these companies could assist with more effective and efficient delivery of these GEOINT products in addition to growing the U.S. market for GEOINT leadership. It is important to note that in January 2020, the Department of Commerce placed a hold on artificial-intelligence-based GEOINT analytics and other related GEOINT technologies, and these regulations may significantly impact U.S. growth and innovation.

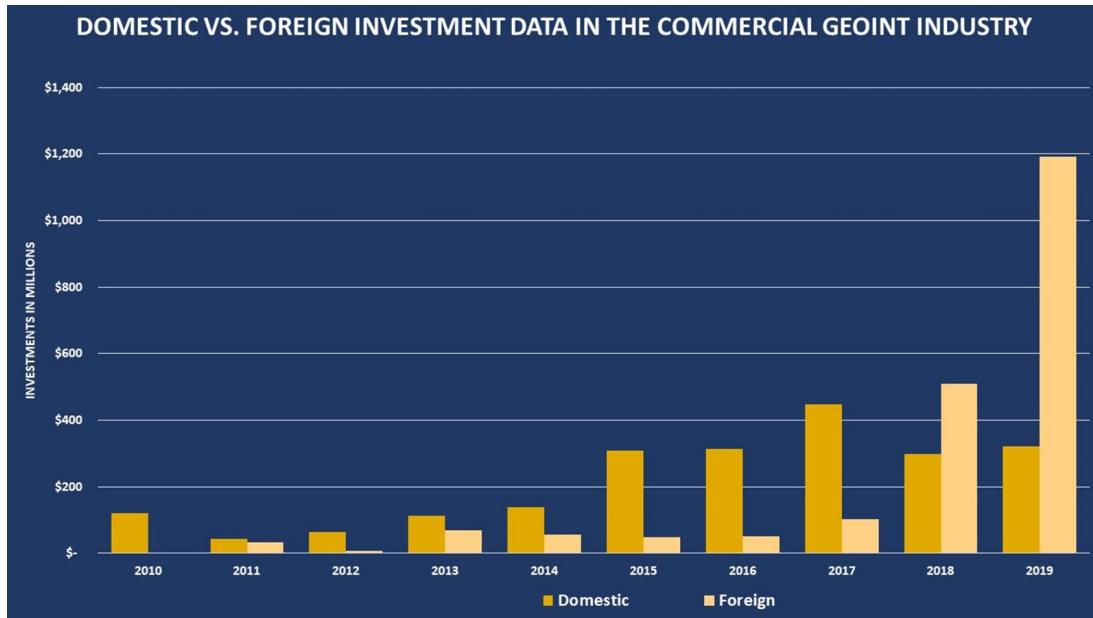


FIGURE 2. DOMESTIC AND FOREIGN INVESTMENT DATA IN THE COMMERCIAL SATELLITE INDUSTRY⁶

Growth in innovation is also significantly impacted by early investment. Figure 2 represents publicly available information on early investment and research and development funding data for the commercial GEOINT market. The data includes seed, venture, and debt financing, and is categorized as domestic and foreign, based on where the investor headquarters are located. This data does not include Operations and Maintenance costs for long-term work, such as the operational EnhancedView Follow On contract NRO has with Maxar. Instead, these metrics are referencing initial investments, primarily funded through research and development.

As is evident in the chart, U.S. investment has been relatively flat over the last five years, while foreign investment has increased tremendously within the last two years. Additionally, the total number of investment opportunities executed by foreign government entities through early funding rounds is nearly seven times the amount of those made by their domestic counterparts. As previously mentioned, the U.S. government initially began investing in commercial GEOINT with the strong intention to help U.S. commercial companies lead the industry. However, the United States has fallen behind, and foreign investment, largely funded by foreign governments, has begun to dominate the industry.

⁶ This report leverages data and information collected and curated in Crunchbase. Crunchbase is a platform for finding business information on public and private companies and includes available investment and funding information. Where applicable, reported financial information on funding rounds for commercial earth-observing space organizations is included to investigate the amount money raised and country of origin of each subsequent investor.

Growth Against Mission

Today, commercial GEOINT largely supports NGA's Foundation GEOINT mission⁷ and an increasing number of intelligence missions as well. Commercial GEOINT is unclassified and sharable with the vast U.S. government, DoD, and IC that NGA serves. It is well suited for map production, safety of air and navigation products, and sharable situational awareness and intelligence for missions such as humanitarian assistance and disaster relief. In addition, unclassified commercial GEOINT is vital to coalition operations such as Southern Command's Countering Transregional Organized Crime initiative, monitoring infectious diseases, and defending against terrorist activities.

The commercial GEOINT demand signal is also growing in the commercial domain as is evident by the increase in commercial GEOINT analytic companies across the globe offering geospatial platforms for customer use. These platforms enable widespread access to a variety of geospatial data, especially satellite imagery. Consumers are using and analyzing imagery at a much faster pace, which means traditional methods of purchasing data are no longer sufficient. Over 150 identified commercial companies include geospatial platforms in their suite of product offerings, suggesting a large customer demand for satellite imagery and derived analytics. As commercial constellations grow in size and diversity, commercial GEOINT can be applied to a variety of U.S. government missions where updated situational awareness, frequent revisit, coordinated collection, and integrated data sets like AIS and imagery can benefit decision makers. For example, monitoring roads, railways, ports, and airfields for changes or indications and warnings can be accomplished with commercial GEOINT at scale.

The unified Geographic Combatant Commanders (GCCs) require continuous awareness of their area of responsibilities to not only provide the situational awareness needed to preserve and protect their theaters but also contribute to courses-of-action development as conditions change. As commercial GEOINT becomes more integrated into the U.S. government architecture, commercial GEOINT is increasingly combined with national systems to aid the GCC in timely decision making. Using commercial GEOINT capabilities, integrated with national systems, supports far faster decision cycles across all joint and services' echelons.

Driven by an increasingly contentious competition with great power rivals as well as the global pandemic recently, the U.S. government is experiencing its own strategic paradigm shift. U.S. government decision makers' needs for faster outcomes require agencies to leverage advanced automation and shift from raw pixels to analytic services. This is an opportunity for the U.S. government to engage with these analytic companies now and influence their sources, analytic strategies, products, and applicable missions.

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⁷ Foundation GEOINT (FG) is the data, products, and services describing the earth's physical and cultural characteristics. FG includes topography, elevation, precise imagery, geodesy, GeoNames and boundaries, human geography, and aeronautical and maritime safety of navigation information. (National System for Geospatial Intelligence, "Geospatial Intelligence (GEOINT) Basic Doctrine" Publication 1.0, April 2018).

A Recognition of Obstacles

Just as the potential opportunities for incorporating more commercial GEOINT products seem to be expanding, obstacles remain. These obstacles are actually opportunities for industry and government to put creative effort toward common ground. The following section looks at three lingering obstacles to forward progress: historical mindset, traditional tradecraft and standards, and regulation that inhibits commerce and competition.

- After years of the best GEOINT being conceived, developed, and exploited within the government, it's not surprising that *a bias exists within the U.S. government against commercial providers*, where personnel think nationally produced GEOINT is superior to commercial and has the least associated security issues. Often, the question of the pedigree of the data becomes a significant issue. This mindset, rooted in history, often causes the government to either disregard outright, or at a minimum accord secondhand status to, commercial GEOINT.
- *One of the most significant areas for discussion is the issue of data standards and the ease of integration.* The U.S. government has traditionally created a standard and imposed it on industry, in large part to simplify government integration and to increase efficiency of workflows. Today, with the private sector being the far more prolific inventor, commercial standards are the de facto baseline, and the government is resistant to their adoption. This resistance to adopting commercial standards and practices and executing flexibility as they evolve is significantly slowing and degrading the efficiency of the government's data acquisition, processing, and analytic services.
- *Current regulation and regulation-creation processes impede commercial GEOINT commerce and innovation*, while at the same time being necessary in areas such as operational security. Policies that restrict industry from the emerging market space serve to inspire new corporate business models unencumbered by U.S. regulations. It should be noted, a new rule by NOAA through the Department of Commerce is rewriting regulations that license the operation of private remote sensing space systems.⁸ Doing so aims to remove any restrictions for capability that already exist in the market and to expedite approval for all remote sensing operators. This new rule is certainly a step in the right direction in terms of decreasing regulatory restrictions on commercial remote sensing. However, it is not yet clear how the new rule will play out and what if any roadblocks or loopholes will be used to stifle the commercial market. As previously mentioned, U.S. regulation and policy on commercial SAR is an historic example of a government impact to limit commercial opportunities.

⁶ Government Publishing Office, Federal Register, Vol. 85, No 3. [Online]. Available: <https://www.govinfo.gov/content/pkg/FR-2020-01-06/pdf/2019-27649.pdf> [Accessed 20 June 2020].

Recommendations

The U.S. government should take the following recommended actions to help the U.S. commercial GEOINT industry become and remain the world leader and for the U.S. government to better leverage that commercial GEOINT growth.

- **The U.S. government should consolidate and share commercial GEOINT needs broadly with the private sector.** The first step is truly understanding the missions and utility of commercial GEOINT. As previously discussed, commercial imagery can support additional missions today, can complement government-produced GEOINT, and can fill many gaps and new missions as they arise. Commercial GEOINT needs can be identified to satisfy those missions and advertised to industry. By continuing open and clear communication, industry can evolve and innovate with government missions in mind, which allows the U.S. government to tap into rapid commercial innovation efficiently and effectively. Coupled with government capabilities, commercial GEOINT can provide the United States with significant technological, strategic, and economic advantages over other state and non-state competitors. Increasing investment incrementally to accommodate the growth and new capabilities will help keep the United States competitive and ahead of the global market. Partnering with commercial GEOINT providers through larger studies and upfront investment in addition to long-term contracts will boost understanding of the GEOINT supply chain and create trust in the pedigree of the delivered data.
- **The U.S. government should adopt universal standards consistent with commercial standards that allow for commercial providers to plug and play into government architectures.** The U.S.

government needs to shift its mindset and think about adopting commercial standards, GEOINT pipelines and processing, and analytical functions. This means integrating government GEOINT practices into commercial GEOINT practices rather than the reverse. This change in approach to the commercial standards GEOINT pipeline and tradecraft may unlock great potential and offer the possibility for rapid innovation and advancement.

- **The U.S. government should strengthen the commercial-first policy and support the new NOAA regulations and process by reassessing U.S. government risk postures for commercial GEOINT concerns.** This new directive includes the “presumption of approval”—rather than industry needing to prove why it should be allowed to do something, government must prove why it should not. Instead of hiding behind the claim of national security and an often biased take on the risks of

BY CONTINUING OPEN AND CLEAR COMMUNICATION, INDUSTRY CAN EVOLVE AND INNOVATE WITH GOVERNMENT MISSIONS IN MIND, WHICH ALLOWS THE U.S. GOVERNMENT TO TAP INTO RAPID COMMERCIAL INNOVATION EFFICIENTLY AND EFFECTIVELY.

new commercial GEOINT, the U.S. government can embrace U.S. leadership and use the insight of future development to update risk postures and remain at the leading edge technologically and with defensive measures. The U.S. government's goal should be, as is presidential policy, to promote U.S. commercial GEOINT and build partnerships with industry. This would be underpinned by the understanding that in a globally connected world, competing with other great powers and operating in the international system require a strong foundation of partnerships and teams aligned to maximize success.

- **The U.S. government should increase investment in commercial analytics.** Given the U.S. government's limited commercial GEOINT

budget, investing in analytics companies could help provide more efficient and effective delivery of derived products and services. As previously mentioned, now is the time to invest in analytics as U.S. companies develop custom products that can be tailored for government missions. The U.S. government should increase advertisement of analytic needs to industry and plan out a long-term operational acquisition for commercial analytics. This not only ensures mission applicability but also helps limit foreign influence on the GEOINT supply chain and use of analytic products in our global and connected world, providing stability to the market and U.S. government.

Conclusions

As the benefits of these services continue to be realized, the demand for GEOINT will only continue to grow. Yet the U.S. government's approach is jeopardizing the U.S. advantage and growing U.S. commercial GEOINT supply. Inhibiting policies and regulations, inability to adapt to the speed of commercial development, and intransigence to adopting commercial standards all threaten the U.S. market in GEOINT. The U.S. government needs to change its approach toward U.S. commercial GEOINT to avoid foreign domination of the commercial GEOINT market and to maintain innovation, technology, economic, and strategic advantages over competitors and adversaries.

The path ahead to do so is grounded in establishing a true partnership between the commercial GEOINT community and the government GEOINT community that reflects the drivers and motivators of both. This, however, extends far beyond the traditional well-known actors and instead involves many branches of government and vendors, technologies, and policies that touch GEOINT. Both the government and industry need to be willing to take short-term risk for long-term gain. Both need to come together in the spirit of equal partners within the GEOINT business line and come to an agreement regarding the risks and opportunities for all.

MITRE is advocating for setting the conditions for an explosive growth and evolution in the use and value of the U.S. commercial GEOINT business line in partnership with the U.S. government. But the government must act now through investment, leadership, support, transparency, and partnership with the commercial GEOINT community to help shape the competition with great power rivals to our advantage and maintain technologic, economic, and military leadership over foreign governments.

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