THE OFFICIAL MAGAZINE

OF THE UNITED STATES GEOSPATIAL INTELLIGENCE FOUNDATION

 Digital natives transform traditional analysis
2019 USGIF Scholarship awards
Q&A with USGIF's Steve Oswald

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Tradecraft and the Power of the Collective

USGIF hosted two recent events at its new Trajectory Event Center that further demonstrated the power of individuals coming together as a community to discuss mission advances and solutions to pressing problems. These sessions highlighted the fact that our community is full of thinkers and doers who understand the power of collaborating with professionals who represent different backgrounds,



JMU student Patrick Muradaz presented at USGIF's inaugural GEOINTegration Summit in September. experiences, and cultures. When we convene communities of diverse individuals, they can apply critical thinking to develop innovative solutions. The GEOINT Community recognizes the interdisciplinary nature of the challenges it faces and the importance of systems thinking. When combined with increasingly available data, new thinking allows magic to happen.

USGIF Working Group representatives and other

interested parties gathered Aug. 27 for the Foundation's first Working Group Summit to share best practices, summarize progress, and define next steps. Working Groups are a secret sauce of USGIF, and it was clear how participants are coming together to drive to improved, alternative futures. For example, the NRO Industry Advisory Working Group has a long-term engagement with NRO leadership, who benefit from the group's continuing, impressive output.

Likewise, representatives and stakeholders in academic GEOINT—to include teachers and students, industry, and government—gathered Sept. 27 and 28 to share ideas at USGIF's inaugural GEOINTegration Summit. For two days, there was a buzz of excitement as ideas were freely shared. The agenda was full of breadth and depth with varied keynotes and panels. Engaging Q&As were followed by networking breaks in which the conversations continued and relationships were established.

We explored technology, but more importantly, we endeavored to understand problems with enough context that the technology can more easily align to form the solution. We recognized the need for accurate translation across different subcommunities. We highlighted the importance of communication and the necessary skill to simply explain complexity. JHU's Jack O'Connor reminded us of the importance of presenting information visually. HiBAR Solutions' Kevin Jackson reflected on the last 15 years of USGIF Awards and the speed of tradecraft evolution and the exponential nature of current problems.

Lifelong education allows us to focus our skill development toward the jobs and challenges that excite us. Two impressive students from James Madison University, Patrick Muradaz and Ian Dunton, clearly demonstrated their developing expertise and passion while providing a detailed understanding of Russian Dragonfly cyber threat actors.

USGIF-accredited universities have awarded more than 1,000 collegiate GEOINT Certificates to date. Our USGIF University brain trust has been instrumental in the evolution of the GEOINT Essential Body of Knowledge version 2.0. As we approach 2020, we as a community understand the specific training and skills development required to mature our thinking to address the social, political, and ethical contexts of the world in which we live.

NGA Deputy Director Dr. Stacey Dixon celebrated the available volume of information while being thoughtful about the limitations of human ability to swim in this ocean of data. She stressed the importance of research and development for the innovative application of technology. Perspecta's Patrick Biltgen reminded us that we should not always seek the model as the result, but more importantly, think about how and what to model.

The leadership, communication, and critical thinking skills demonstrated by our community give me confidence we can significantly contribute to solving the world's most pressing problems. If you have participated in a recent USGIF event, I thank you. And if you have not, I invite you to open your eyes to opportunities for engagement and join us on this journey. After all, the dog that stays on the porch will find no bones.

THE HONORABLE JEFFREY K. HARRIS CHAIRMAN, USGIF BOARD OF DIRECTORS

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NTSICE *COMMUNITY NEWS, EVENTS, AND EDUCATION*



SPECIAL EVENT

James Clapper on the Foundation of GEOINT

A standing room only crowd of GEOINT professionals gathered Sept. 10 as a jovial James R. Clapper, former Director of National Intelligence, reminisced about the early days of both the National Geospatial-Intelligence Agency (NGA) and USGIF. The audience was attending a special GEOINTeraction Tuesday networking event, sponsored by Vricon, to celebrate the grand opening of USGIF's Trajectory Event Center (TEC).

USGIF's founding Chairman of the Board Stu Shea and current Chairman The Honorable Jeffrey K. Harris stood alongside Clapper, the first director of NGA, to perform the official ribbon-cutting for the new facility.

CLAPPER'S LEADERSHIP

- 2010-2017	Director of National Intelligence
→ 2007-2010	Under Secretary of Defense for Intelligence
- 2001-2006	Director of the National Geospatial- Intelligence Agency
- 1992-1995	Director of the Defense Intelligence Agency

Clapper began his remarks by sharing a personal story about one of his earliest intelligence collection ventures. The setting was the summer of '53 in Philadelphia, where young Jim Clapper and his sister were visiting their grandparents. One night, while tinkering with the television knobs, he suddenly heard voices but saw no picture.

"I soon realized it was the Philadelphia Police Department dispatcher," Clapper recalled. "The next night, I got a map of the city of Philadelphia and began plotting the police codes."

The would-be intelligence officer soon found himself sleeping all day and "working" all night. A few days later, when his parents returned, Clapper's father, who was an Army intelligence officer, asked what he had been up to.

"So, I pull out my map and my 3x5 cards and give him a 20-minute discourse on the operation and organization of the Philadelphia Police Department," Clapper said. "I still remember the expression on my dad's face, 'My God, I've raised my own replacement."

As the room erupted with laughter, Clapper explained why he told this story: to illustrate the nature of intelligence.

In 2001, two days after $\forall / 11$, James Clapper became the first civilian director of NGA's predecessor organization, the National Imagery and Mapping Agency (NIMA).

"You are always dealing with incomplete information and you build hypotheses and then you try and test those hypotheses," Clapper said. "Even then, you don't have complete information, so you are trying to build an assessment."

A NEW INTELLIGENCE DISCIPLINE

Clapper also shared some anecdotes from the inception of both NGA and USGIF it all started with tradecraft and mission.

In 2001, two days after 9/11, he became the first civilian director of NGA's predecessor organization, the National Imagery and Mapping Agency (NIMA). Soon after becoming director, he began to re-define how NIMA would better serve its national security mission.

Clapper described receiving a report produced by the NIMA Commission as the genesis of NGA. The commission reported that timely development of a robust geospatial information system was critical to achieve national security objectives in the 21st century.

"The name itself, the National Imagery and Mapping Agency, was divisive," Clapper said. "So, the two cultures (imagery and mapping) had pretty much remained separate."

Under his leadership in 2003, with the goal to integrate the sources and tradecrafts, Clapper helped to coin the term geospatial intelligence (GEOINT) and appealed to Congress to change the organization's name to the National Geospatial-Intelligence Agency (NGA). The new name was made official in 2003, when Congress passed the National Defense Authorization Act.

Later that same year, Stu Shea worked with members of the burgeoning GEOINT Community to stand up an organization to help advance the new tradecraft.

"The idea early on was to forge a partnership with industry," Clapper said. "USGIF has grown and flourished as a tremendous outreach

for industry, and what it does with and for people is phenomenal. The most important aspect of intelligence is people and we need to continue providing this invaluable platform to advance the tradecraft, accelerate innovation, and build the community."



Isaac Zaworski (left) and Barry Tilton (right) of GEOINTeraction Tuesday sponsor Vricon provided a technology demonstration to former DNI James R. Clapper.

"USGIF has grown and flourished as a tremendous outreach for industry, and what it does with and for people is phenomenal."

PROCRASTINATION TOOLS

SOS Explorer

The National Oceanic and Atmospheric Administration's (NOAA) Science on a Sphere (SOS), typically found in



museums, is now available as a mobile app. Using SOS, you can see animated images portraying everything from atmospheric storms and climate change to Saturn's rings. Select the dataset you'd like to see and display it on a virtual globe. Some sample datasets available include recent hurricane seasons, bird migration patterns, ocean currents, historical tsunamis, underwater imagery, air traffic, and more. *Available on iOS and Android*

OldNYC



Take a self-guided historical tour through New York City. Historic photos pop up near the user's current location. The more than 40,000 images come from the NYC Public Library repertoire and span the last 50 years. Tourists will experience a whole new way to discover the city's vibrant past. Locals have a way to visualize the stories they heard growing up. Developers say they plan

to add many more features including a "timeline sifter" to comb through different periods. *Available on iOS*

Moon Globe HD

Moon Globe HD turns your device into a precision instrument to view Earth's moon. Combining satellite imagery and topographic laser altimeter data renders images of the moon with realistic lighting in real-time 3D. The sky compass projection feature, based on angular elevation, indicates how high the moon and sun are in the sky. Users can also



determine where the moon and sun are with the dynamic sky compass. Switch to telescope mode to see the moon as it appears from your location. *Available on iOS*



NGA Deputy Associate Director for Capabilities Sandra Auchter spoke and answered questions from attendees during a USGIF event at The View of DC.

GEOINTERACTION TUESDAY

NGA's Role as a Data Organization

"[We] have to prepare for what is coming down the pipe. ... We see the light at the end of the tunnel and if you're not prepared for it, it could be a train."

- SANDRA AUCHTER, NGA

NGA Deputy Associate Director for Capabilities Sandra Auchter spoke about the broad scope of the agency's capabilities, from main focus areas to data standardization, July 23 at USGIF's GEOINTeraction Tuesday event sponsored by Orbital Insight.

To support GEOINT mission requirements, Auchter said her office aligns capabilities under three focus areas: Mission Now, Mission Next, and Innovation.

"Mission Now" is about ensuring current capabilities are delivered seamlessly to agency and partner end users.

"We are not just delivering capabilities for our agency," Auchter said. "We are also delivering capabilities for our senior partners, warfighters, services, and our third-party partners."

"Mission Next" is about preparing for what's on the horizon and concentrates on expectations for the near future.

"This is a visible future," she said. "[We] have to prepare for what is coming down the pipe. ... We see the light at the end of the tunnel and if you're not prepared for it, it could be a train."

The last focus area, "Innovation," is less tangible.

"[Innovation is] not something you can see or that has requirements. It is something where you all can help," she said, addressing industry in the audience.

Auchter also referenced what she called NGA's role as a data corporation, saying the agency is in the business of data in addition to GEOINT.

"We have been in the data business for a long time, but we haven't articulated that," she said.

During Q&A, Auchter was asked to elaborate on NGA's role as a data organization. When she was an analyst, she explained, there were fewer sources that were easier to manage compared with the modern influx of sources. Today, she continued, GEOINT professionals are not just delivering pixels, but providing data and insights.

Standardizing the deluge of data represents a significant challenge, according to Auchter. Doing so, she continued, will require increased communication between NGA's Source and Analysis Directorates regarding data standards.

Auchter concluded one of her goals is to identify data conditioning standards.

"We are going to have to make decisions in the future on balancing how it is we go back and condition [the data] we have now and create standards for that to come later."

CERTIFICATION

USGIF Introduces Entry-Level GEOINT Credential



USGIF recently announced the addition of an entry-level GEOINT certification to its suite of professional designations. "The Essentials" exam is intended for recent graduates and young professionals in the GEOINT field to demonstrate their knowledge across the foundational competencies outlined in

USGIF's GEOINT Essential Body of Knowledge (EBK).

USGIF piloted The Essentials exam in partnership with 10 of its accredited college and university programs. Of the 90 students who participated in the pilot exam, 57 passed, yielding a promising success rate of 63%.

"This is a first but strong iteration of an entry-level exam that did not exist for the community," said Dr. Camelia Kantor, USGIF's Vice President of Academic Affairs. "In time, with more recent graduates and young professionals taking the test, we will be able to adjust the exam to even better reflect a broader GEOINT base. USGIF is committed to updating the exam to ensure it is a good representation of foundational knowledge and an accurate measure of individual knowledge attainment."

The pilot exam was a success thanks largely in part to the engagement of USGIF-accredited universities.

"I was delighted to coordinate this effort on the UNCW campus and to see the excitement with which students took advantage of the opportunity, knowing they would thus have an independent assessment of their GEOINT skills," said Dr. Narcisa Pricope, Associate Professor of Geography at the University of North Carolina Wilmington. "We

ing UNCW steer our next faculty hire."

ment of their GEOINT skills," said Dr. Narcisa Pricope, Associate Professor of Geography at the University of North Carolina Wilmington. "We were thrilled to receive our aggregated results that highlighted not only where we excel, but also areas of

Of the 90

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yielding a

promising

7 passed,

Visit usgif.org/certification to learn more about The Essentials and Certified GEOINT Professional exams.

improvement. The results of this pilot are already help-

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INTsider



Learning new skills and bridging career gaps were two of the topics discussed at USGIF and INSA's "Mid-Career Reboot: Challenges and Choices" event.

Building Your Career Lattice

Have you ever wondered how to transition your career from the Intelligence Community (IC) to the private sector or vice versa? Or how to transfer to a different intelligence agency or even to a new role within your current agency?

Career coaches and professionals who have successfully made such transitions shared insights to these common questions July 22 at USGIF and INSA's "Mid-Career Reboot: Challenges and Choices" event in Arlington, Va.

Preston Golson, director of the Brunswick Group and a former CIA employee, urged attendees to consider how their skills can transfer to other industries.

INSA President Chuck Alsup introduces speakers from both government and industry.

"Never shortchange your skill set," Golson said. "The core component of why I got hired [in my current role] was my ability to deal with complex information and make it understandable for clients."



Kelly Brickley, who transitioned from a career with the Office of the Director of National Intelligence (ODNI) to her current role as senior director of cyber risk at Capital One, emphasized the importance of humility and adaptability.

"Know the skills you're bringing but be willing to go out and learn the other puzzle pieces," she said, describing how she learned to code and decided to pursue new certifications upon joining Capital One. "Learn new skills but be confident in what you bring to the table."

Deirdre Walsh, COO at ODNI, described how the IC is evolving alongside the rest of the world, striving to keep pace with modern challenges such as big data, cybersecurity, and increasing interconnectedness.

"This is a world with more threats and more access to information than in the past," Walsh said.

As such, ODNI is championing an "agile workforce," exploring ways for intelligence personnel to work beyond the SCIF and the beltway. Walsh added that ODNI is "working tirelessly" on security clearance challenges, including those that allow for easier movement of talent between agencies and the public and private sectors.

Walsh also said, as opposed to the term "career ladder," she is a proponent of the term "career lattice," which, especially for more experienced professionals, represents the ability to move laterally and to pursue new experiences.

Concluded Golson: "The beauty of an intelligence career is you can have many careers within your career."

Cross-Disciplinary Conversations

USGIF hosted its first ever Working Group Summit Aug. 27 at the Foundation's new, state-of-the-art Trajectory Event Center in Herndon, Va. Nearly 75 individuals attended to learn about the Foundation's many initiatives across its eight working groups as well as its Tradecraft & Professional Development Committee.

Zach Jett and Roy Pettis from the Office of the Director of National Intelligence's (ODNI) Acquisition, Procurement, and Facilities Office kicked off the summit with a keynote update on ODNI's Acquisition Agility Strategic Initiative.

"Acquisition agility doesn't mean I'm going to throw away all the things that have gotten us to a good place," Pettis said. "But it does mean not every program is the same."

Jett said NGA has already created its own "acquisition agility playbook" that the ODNI team is adapting to an online, interactive guide for use across the Intelligence Community (IC).

Jett compared the concept to the use of assistive software such as TurboTax: "I don't know how to do my taxes, but I do with TurboTax," he explained. "Wouldn't it be great if we could do the same thing with contracting?"

The summit was a great opportunity for USGIF Working Groups to engage in cross-discipline brainstorming as well as to gather input from the larger GEOINT Community, according to USGIF Vice President of Programs Ronda Schrenk.

"The morning keynote set the stage for ongoing interaction against the backdrop of the implementation of new acquisition and procurement pathways across the Intelligence Community," Schrenk said. After the keynote, each Working Group had the opportunity to present a flash talk regarding its respective mission and activities. The talks were followed later in the day by workshop-style discussions and opportunities for smaller, breakout conversations.

Many pathways for collaboration emerged from the discussions. For example, the NRO Industry Advisory Working Group and the Young Professionals Working Group discovered a common thread through which to partner. Additionally, the potential to expand the Small Business Advisory Working Group to the St. Louis, Mo., area

was identified. USGIF Chairman The Honorable Jeffrey K. Harris shared a proposed charter for a new USGIF Working Group focused on intellectual property and data rights.

Harris pointed to the convergence of data and location, and said he believes the GEOINT industry, like the rest of the world, will soon experience a shift toward managed data subscription services.

"This group would focus on data ownership, use, and understanding," Harris said.

The proposed group piqued the interest of several attendees, said Schrenk, adding that the Foundation will make a decision about whether to establish the new Working Group by the end of the calendar year.

Several Working Groups discussed their respective initiatives and shared knowledge at the USGIF Working Group Summit.



The USGIF Working Group Summit was a great opportunity for Working Groups to engage in cross-discipline brainstorming as well as to gather input from the larger GEOINT Community.

Delta State University Earns USGIF Accreditation

Delta State University in Cleveland, Miss., has earned USGIF Collegiate Accreditation for its Geospatial Analysis and Intelligence (GAI) bachelor of applied science program. Delta State is the first undergraduate degree program to achieve USGIF accreditation, bringing the total number of colleges and universities the Foundation has accredited to 16.

The BAS-GAI degree can be earned on-campus or online and is offered through Delta State's Center for Interdisciplinary Geospatial Information Technologies.

"Accreditation of our degree program signals the formal birth of a new academic discipline: Geospatial Analysis

Visit usgif.org/ education/accreditation to learn more about the Foundation's Collegiate Accreditation Program. and Intelligence," said Talbot Brooks, director of Delta State's Center for Interdisciplinary Geospatial Information Technologies. "GEOINT was bundled up under geography and related disciplines for too pe is overdue. Seeking

long and its emergence as a discipline is overdue. Seeking both regional and professional accreditation was a long and difficult path, but we are glad to be the first and are committed to forever being the best."

The Center works cooperatively with non-profit organizations such as USGIF and industry partners to deliver a curriculum of significant value to employers.

Beyond coursework, BAS-GAI students must engage in a full semester of cooperative education, working real-world projects with program partners such as NGA, Hexagon Federal, and USDA-NRCS.

Chosen as a Center of National Excellence in the Geosciences by NGA and the U.S. Geological Survey, the Center is also a partner of the U.S. military and emergency



response communities. Its faculty serve on the National Geospatial Advisory Committee, as technical advisors to the United Nations, and have served as members of the National Academy of Science.

"Despite the institution's rural location, its GEOINT program has capitalized on outreach efforts to build hybrid programs in which students work on real-world projects," said USGIF Vice President of Academic Affairs Dr. Camelia Kantor. "Delta State is a hidden gem that has earned its seat alongside an elite group of GEOINT programs."

NEW ACCREDITED PROGRAM

USC Offers First USGIF-Accredited M.S. in Human Security and GEOINT

The University of Southern California's Spatial Sciences Institute has developed and is now offering the first USGIF-accredited Master of Science degree in Human Security and Geospatial Intelligence.

"USC is the perfect example of how geospatial intelligence certificate programs can mature, transform, and take on different dimensions—in this case by identifying and capitalizing on the value of human security in GEOINT," said Dr. Camelia Kantor, USGIF Vice President of Academic Affairs. "Building upon a sustainably grown GEOINT Certificate program, USC aims to educate future leaders in location-based analytics by gathering and interpreting relevant data as well as creating and implementing actionable intelligence, all in support of human security."

This newly accredited degree is in addition to USC's Graduate Certificate in Geospatial Intelligence, which earned USGIF accreditation in 2015.



A Strong Small Sat Demand Signal

The U.S. Department of Defense (DoD) has a strong appetite for small satellite technology, according to Arsenio (Bong) Gumahad II, director of the C4ISR Division, Information and Integration Portfolio Management, with the Office of the Under Secretary of Defense (OUSD) for Acquisition and Sustainment.

Gumahad, who gave a keynote address Sept. 24 at a Commercial Space Policy Breakfast hosted by USGF's Small Satellite Working Group, provided an overview of what he described as "a small sat coordinating activity" underway at OUSD.

About a year ago, Gumahad explained, as part of the FY19 budget review process, OUSD wrote an issue paper that recognized potential inefficiencies in how the DoD is approaching small sat programs.

"We suspected, and the study documented, that there were multiple programs within the DoD

and Intelligence Community (IC) that were being done independent of one another—with little cross-flow of information across the enterprise," he said.

As a result, OUSD's three-phase coordinating activity is now working with stakeholders across DoD and the IC to identify ways to gain efficiencies in terms of budget, technology, and beyond.

In phase 1, the activity identified 17 separate small sat programs across U.S. agencies and military services, ranging in focus from prototyping and communications to ISR and weather. One common thread was a lack of integration.

Now in phase 2, OUSD is "drilling down into more detail" and examining ways for DoD to provide some common services across the board, Gumahad said. Primary focus areas are command and control, PED capabilities, and launch.

"For each element, we are expanding the scope to see how the Department can best offer services," he said, adding a major priority for phase 2 and 3 will be to make the U.S. small sat launch base more successful.

OUSD made two significant findings in reviewing the health of the nation's small sat launch business, according to Gumahad:

Of the more than 50 U.S.-based companies claiming to offer small sat launch capabilities, there are only a "handful" OUSD considers viable in terms of financial



backing, technology demonstration, and prototype testing.

Of all DoD and IC small sats expected to launch between now and 2028, only 17% require a singleuse launch capability—the rest are ripe for ride-sharing.

In addition, foreign competition is a growing concern.

"A lot of these companies are actually being subsidized by their own government, offering inexpensive launch rides," Gumahad said.

Moving forward, OUSD is looking at ways to "incentivize the industrial base, specifically for launch services" and to demonstrate a strong DoD "demand signal."

"The goal is to develop a roadmap not only for technology, but in terms of capabilities we would like to see from a DoD standpoint in the five- to 10-year timeframe," Gumahad concluded. "To show where we're going, to signal the fact that this is an area of interest for DoD, and that we want to keep it in the U.S." OUSD's Arsenio (Bong) Gumahad II shared how his office is looking to drive efficiencies across DoD and IC small sat programs as well as to incentivize U.S.-based launch.

Of all DoD and IC small sats expected to launch between now and 2028, only

17% require a single-use launch capability—the rest are ripe for ride-sharing.

Instead of deserts and jungles, future wars might be fought in and under cities. With urban and underground warfare

FIGHTING ON

looming, GEOINT takes center stage.

BY MATT ALDERTON

CITIES ARE LIVING, BREATHING THINGS.

Like organisms, they're constantly changing. In the 19th century—before indoor plumbing, electricity, or automobiles—the typical city was a cesspool of decay, disorder, and disease. Without municipal police departments, traffic laws, or indoor plumbing, streets were congested with crime, horses, and waste. Streets were narrow, buildings short, and apartments overcrowded. Skyscrapers? Ridesharing? Condominiums? Urbanites of the past could not have even imagined the cities of today. >>

ONE WORLD TERRAIN

Redefining military readiness through virtual simulation training for urban engagements

Of course, cities are still changing. In a few short decades, futurists predict, cars will drive themselves, buildings will generate their own energy, drones will police streets, augmented reality will make streetscapes searchable, and high-speed hyperloops will transport passengers really far, really fast. Urban planners hope for cities of the future to be smart, sustainable, and safe.

Unfortunately, some of them might also be warzones, according to the U.S. Army, whose Army Future Studies Group (AFSG) has identified megacities—cities with populations of 10 million people or more—as a growing concern for the U.S. military.

"Megacities are rapidly becoming the epicenters of human activity on the planet and, as such, they will generate most of the friction which compels future military intervention," AFSG, formerly known as the Army Chief of Staff's Strategic Studies Group, said in its 2014 report, "Megacities and the United States Army: Preparing for a Complex and Uncertain Future." To ignore megacities, the report said, is to ignore the future.

The U.S. Army Training and Doctrine Command echoed AFSG's sentiment in its 2018 pamphlet, The U.S. Army in Multi-Domain Operations 2028: "Dramatically increasing rates of urbanization and the strategic importance of cities ... ensure that [future] operations will take place within dense urban terrain."

But urban terrain isn't just dense. It's also diverse. Along with threats aboveground—on roads and rooftops or inside buildings—warfighters in cities might also face threats belowground in basements, sewers, subways, and tunnels.

The United States has already faced and defeated enemies both in and under cities. Across the Department of Defense (DoD), however, there's an acknowledgment that what was once the exception might one day be the rule. And so, military leaders have begun laying a foundation on which to build a future fighting force that's as ready to engage in urban and underground environments as it is in conventional domains. There's just one thing they need to complete their mission: more and better geospatial intelligence (GEOINT), which is being developed thanks to forward-looking programs such as the Army's One World Terrain (OWT) and the Defense Advanced Research Project Agency's (DARPA) Subterranean (SubT) Challenge.

"The military has recognized that no domain is an unreasonable place to assume we might have to engage," explained Barry Tilton, chief technical officer for U.S. federal operations and vice president of engineering at 3D

"Physically controlling an urban population consisting of tens of millions of people spread over hundreds of square miles with military forces numbering in the tens of thousands not only ignores the force ratios recommended in doctrine but actually inverts them." GEOINT provider Vricon. "Because the world is nothing but a series of constantly changing political and environmental circumstances, they're saying, 'Let's prepare to engage anywhere engagement might happen." ... Whether that's a cityscape or a tunnel: The more knowledge you have about the landscape and where you are in it, the more effective you're going to be."

URBAN OBSTACLES

Armies have typically waged land wars in remote or rural areas, away from major population centers. During the Civil War, for example, the Battle of Gettysburg raged mostly in the open fields surrounding the Pennsylvania town. World War II's Battle of the Bulge unfolded in the dense forests of Belgium, and the Vietnam War's Battle of Hamburger Hill in the jungle-cloaked mountains. Even Operation Enduring Freedom took place predominantly in the rugged mountains of eastern Afghanistan.

There have been urban battles, too—Aachen, Germany, in 1944; Hue, Vietnam, in 1968; Mogadishu, Somalia, in 1993—but cities are generally a theater of last resort.

There are good reasons why, according to Patrick Cozzi, CEO of Cesium, a geospatial software company whose platform enables 3D applications based on real-world geospatial data.

"Urban environments are infinitely more complex than open land where you can see everything," explained Cozzi. "Ingress and egress—getting in and out of multi-story buildings—and being able to understand the movement of people to precisely target bad actors and avoid civilians ahead of time and in real time are key challenges."

Both the challenges and the potential fallout—including widespread destruction and high numbers of casualties—can be even greater in megacities, of which there will be 43 by 2030, according to the United Nations. Most of these cities will be in developing regions, and 37 of them will be 200 to 400% larger than Baghdad, where U.S. forces spent nearly a decade engaged in urban conflict during the Iraq War. While some 6.5 million people live in Baghdad, New Delhi has a population of 29 million and Shanghai a population of 26 million. Mexico City and São Paulo, meanwhile, each have approximately 22 million inhabitants, while Cairo, Mumbai, Beijing, and Dhaka each have nearly 20 million.

According to AFSG, current U.S. Army doctrine calls on troops to "isolate and shape the urban environment and to utilize ground approaches from the periphery into the city." But in cities with so many people, that doesn't work.

"Physically controlling an urban population consisting of tens of millions of people spread over hundreds of square miles with military forces numbering in the tens of thousands not only ignores the force ratios recommended in doctrine but actually inverts them," AFSG explains in its "Megacities and the United States Army" white paper. "Virtual isolation is even more improbable given cellphone saturation in urban environments worldwide and global interconnectedness through the World Wide Web. Ground maneuver from the periphery is also unrealistic. The congestion of ground avenues of approach, combined with the massive size of the megacity environments, makes even getting to an objective from the periphery questionable, let alone achieving an operational effect."

But it's not just doctrine that falls short in megacities, it's also maps.



"If a company commander or squad leader wants to see what's up over the hill for route planning or threat analysis, they need a level of resolution, fidelity, and currency that you can't get currently," said Ryan McAlinden, director of modeling, simulation, and training at the University of Southern California's Institute for Creative Technologies (ICT), a DoD-sponsored University Affiliated Research Center that works collaboratively with the U.S. Army Research Laboratory.

The deficit is especially apparent in urban environments, which necessitate a three- instead of a two-dimensional vantage point.

"Our world is inherently 3D," Cozzi said. "In an urban environment where there are buildings that can have overhangs and multiple floors, the third dimension is key to having situational awareness—where I am, what I can see, if there are other actors, where they are, what they can see, and what the potential is for mobility across all three dimensions: X, Y, and Z."

Unfortunately, 3D data so far have been limited to crude sources like NASA's Shuttle Radar Topography Mission, which provides global elevation data at 30meter resolution.

"That's pretty much useless. You can't do anything in an urban area with 30-meter data, except perhaps some basic flight planning to make sure you don't hit buildings," McAlinden said. "Even 1-meter or sub-meter data is of marginal use in urban areas. Because of the density of structures and the slope contrast—you have very sharp edges that because they're manmade are less organic and very perpendicular to the ground—you really need highresolution content."

TRAINING FOR TOMORROW

Generating, federating, and utilizing high-resolution 3D content is the focus of the Army's OWT program, the outcome of which will eventually be a realistic and accurate geo-specific 3D map of the world that the Army can use to train warfighters for future conflicts—including those in megacities.

OWT—the 3D geospatial database that will underpin a larger virtual training platform known as the Synthetic Training Environment (STE)—is in some respects a direct response to AFSG, which stated plainly in Megacities and the United States Army that "the Army is not prepared for operations" in megacities, and that "entirely new concepts are needed" to bridge the gap.

OWT is, indeed, an entirely new concept. Led by Maj. Gen. Maria Gervais, director of the Army's STE Cross Functional Team, the OWT effort will pursue American strategic advantage by addressing a geospatial gap in the Army's current training regime.

"We have to be able to replicate in a training environment whatever operational environment a soldier or commander might face in the future," Gervais said. "Our current training environment does not allow us to do that." One World Terrain enables soldiers to rapidly gain an understanding of the environment, build a plan, and rehearse the mission using the terrain on which they will be training or fighting—even in complex theaters such as jungles or megacities. The Army's current training platform, the Integrated Training Environment, was built using gaming technology from the 1980s and '90s. Replacing it with modern technology—virtual simulations with high-resolution 3D imagery—will redefine U.S. military readiness.

"Although they've been really good for a number of years, game simulations are not designed to support real data within their systems. In order to minimize file sizes, they tend to fill in textures of buildings and create generic structures," said Tilton of Vricon, which is building OWT for the Army using its large-scale 3D mapping solution. "One World Terrain is about moving from that environment to one where if you're simulating Paris, not only will the Eiffel Tower be in the right place—which happens in simulations now—but so will the buildings around it, the walkways going up to those buildings, and the restaurant you remember eating at down the street."

Wherever they're going to deploy, soldiers can rehearse tactical warfare as if they were there already. That's especially valuable in the context of densely populated urban environments where it's not feasible to conduct realistic live training.

"The ability to virtualize an environment—to see it on the ground as it is ahead of time—is so powerful," explained Gervais, adding that hyper-realistic virtual training environments help soldiers strengthen their decision-making, develop cognitive skills, enhance teamwork, reinforce self-confidence, and build muscle memory.

To realize its OWT vision, the Army must solve myriad challenges that are familiar to the GEOINT Community. One is spatial and temporal resolution. To get the best and most current view possible, Vricon is building a foundation layer of 3D GEOINT using half-meter commercial satellite imagery from Maxar, which co-founded Vricon with Saab in 2015. On top of that, the Army can then add a high-resolution tactical overlay layer comprising 2- to 15-centimeter data collected by unmanned aerial systems (UAS), manned aircraft, ground vehicles, etc. "OWT will have a ... foundation built from satellite imagery to enable consistent and accurate registration of datasets acquired by other sources," said Cozzi of Cesium, which is partnering with Vricon to execute OWT's 3D requirements. "These datasets may be more recent or higher resolution or both, depending on the source. The system must be flexible enough to accurately make use of the best available source data—wherever it might come from—to produce the most detailed result possible."

In that way, soldiers themselves become sensors.

"We will take source data from national technical means and commercial satellites, but we also will produce our own source data," said McAlinden of ICT, which is conducting research and development in support of OWT and the STE. "Units themselves are going out and collecting imagery and then feeding that imagery into the One World Terrain pipeline to produce highly resolved, highly accurate geo-specific content."

Several hundred of these UAS 3D mapping kits have been deployed to Army, Marine Corps, and Special Operations units, members of which can use mobile devices to define areas they wish to simulate for training purposes. UAS then automatically survey the defined areas to generate terrain models from which individual features (e.g., roads, vegetation, buildings, doors, windows) can be extracted and classified. GEOINT is subsequently processed, stored, and distributed to soldiers in the form of simulations they can access anywhere and on any device, including virtual reality goggles that allow them to interact with training environments as if they were actually in them.

"We want to be able to take all the terrain data that's out there ... and make it simulator- or game engine-agnostic so we can quickly bring it into applications for soldiers to train on," explained Gervais, who said depicting roads, structures, and trees in the right location is just the first step in providing accurate terrain representations. The 3D model also requires terrain features with appropriate



games, military simulations require 3D terrain features that exhibit the appropriate attributes. Wooden structures, concrete buildings, and vegetation must react realistically to battlefield effects to better support mission planning and reduce the potential for negative training.

Unlike popular

attributes to support realistic training. For example, a muddy street or dirt trail must constrain vehicles more than an asphalt highway, and concrete walls must react differently to munitions than wooden ones. Machine learning and artificial intelligence are accelerating the assignment of appropriate attributes during the collection and processing phases with the help of cloud computing.

"It's not just about realism in the pixels; it's about having semantic data," Cozzi said. "The fusion of highly accurate 3D geospatial data with the semantics that describe that data ... opens up a whole new level of uses cases beyond visualization."

The key to the entire workflow, according to Gervais, is open architecture that allows terrain data to flow freely among media.

"Different training systems traditionally have required different data formats at different levels of resolution," said McAlinden, adding that terrain data currently exists in 57 different formats suited to disparate Army training systems. "If you were doing a tank simulator, an aviation simulator, and a ground simulator, you had to build terrain for every single one of them because there wasn't a mechanism to move them in a concise, coordinated, accredited way. ... The STE will consolidate all these different training systems into one, with one foundational terrain dataset."

With one system instead of 57, training programs will advance from conception to implementation more quickly, more affordably, and with fewer stovepipes.

"The vision obviously is quite grand," said McAlinden, acknowledging that grand visions face grand challenges. Because of the type and size of data involved, those challenges include data storage, distribution, conflation, and accreditation.

Solutions are underway, according to Gervais, who said OWT is on track to deliver its initial operational capability at the end of 2021 and its full operational capability in 2023. Based on early feedback from soldiers—who might also be able to use OWT data beyond training, to include mission planning, mission rehearsal, and even operations success is imminent.

"We still have a lot of things to work out," Gervais said, "but it's already proven its value."

HIDDEN THREATS

While it's designed to simulate virtually any environment on Earth, OWT will be especially useful in helping warfighters prepare for urban combat.

"To practice warfare, usually you have to break things," Tilton said. "Obviously, you don't want to break real cities, and building a pretend city is not easy."

Virtual cities are, therefore, an ideal solution.

The same logic applies to another, aforementioned Achilles heel in U.S. military readiness: underground environments. Though the Army promises underground terrain will figure just as prominently in OWT as aboveground terrain, it demands a different approach.

"Cities are relatively easy to model because we can take enough pictures to build maps, and because there's a lot of supporting data from everyone on the planet taking selfies with their cellphones. But because the whole point of underground facilities is to protect certain resources and assets, there are very few models available of what they actually

"Our adversaries feel threatened ... so they're protecting themselves from observation and attack by putting distance and rock between us and by keeping their precious assets concealed."

-GUNNAR RADEL, UNDERGROUND FACILITY ANALYSIS CENTER

look like," continued Tilton, who said the Army is hard at work on solutions that will give it the access and technical means it requires to capture geo-specific subterranean data.

The Intelligence Community recognized the paucity in subterranean GEOINT more than 20 years ago. In 1997, the Defense Intelligence Agency (DIA) stood up the Underground Facility Analysis Center (UFAC). A DIA-managed consortium of co-located intelligence professionals from DIA, the National Geospatial-Intelligence Agency, the Defense Threat Reduction Agency, and others, UFAC's mission is to unearth—literally—information about adversarial underground facilities.

"The underground 'problem' has been growing for many years now," said UFAC Senior Engineer and Analyst Gunnar Radel. "It's growing in the quantity [of underground facilities] that our adversaries are building and in the number that they have, the quality of the sites that they're using, and the scope of application."

Adversaries increasingly are burying not only topsecret facilities, but also weapons and other sensitive assets. Simultaneously, there is an increase in underground civilian infrastructure and in underground activity by non-state actors.

"Our adversaries feel threatened ... so they're protecting themselves from observation and attack by putting distance and rock between us and by keeping their precious assets concealed," continued Radel, who said subterranean construction simultaneously has become more affordable and feasible for both military and civilian developers. "The technology has improved to the point where there's not too many places anymore that you can't build underground. At the same time, we're running out of surface space, so countries are looking to build vertically down in major cities instead of vertically up like they have in the past."

Because underground environments are hidden from surveillance, all of this adds up to a significant GEOINT opportunity. "UFAC has an incredible, insatiable appetite for GEOINT," said Radel, whose team is trained to detect and characterize underground facilities by analyzing aboveground terrain. As the subterranean domain grows in size and strategic importance, however, more advanced tools and techniques are needed.

Radel is bullish about machine learning.

"Our priority is to optimize our most precious analytic resource, which is the analyst's time," he said. "We're looking at how much can be automated upstream before our analysts even have to engage ... [which will help them] mine the gems and nuggets out of the mass quantities of data coming in."

>Continued on page 20

THERE'S ALWAYS MORE THAN MEETS THE EYE

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As ice melts, new corridors form for travel and resource exploitation. While Arctic ownership remains highly contested by nations, RF detection of maritime VHF radio signals shows that activity in this once barren region has quietly picked up. What was once a land of ice is starting to show new patterns of life.

Bring hidden vessels to light

Not everyone on the sea wants to be noticed. Near Korea and Japan, a region combating illegal fishing and smuggling, RF detection of X-band navigation signals can help locate vessels that may have turned off AIS. With a better view of the waters, authorities can find ships trying to hide.





Detect anomalous behavior

In the rural woods of Canada, trees provide the perfect coverage for activity on the ground. However, UHF push-to-talk radio signals can be detected through the foliage, alerting observers to anomalies and unusual behavior in this remote region, in case further investigation is required.





THE SUBTERRANEAN CHALLENGE

Without GPS, underground mapping requires automation, perception, mobility, and networking

BURIED TREASURE

Eleven teams from eight countries gathered in Pittsburgh, August 15-22, 2019, to attempt to map, identify, and report artifacts along the passages

of two mines. Team CERBERUS lines up its autonomous platforms in preparation for entering the Safety Research Coal Mine.

While UFAC is investing in better analysis of subterranean GEOINT, its partners in the research community are developing means with which to better collect it. Namely, DARPA, which in September 2018 launched its SubT Challenge, an underground robotics competition with the objective to incubate new technologies to assist with navigating, mapping, and otherwise surveying complex underground environments.

"In places where we don't have access to GPS and other ways to geo-rectify the data that we have, it's a severe limiter. One of those places is the underground," said SubT Program Manager Timothy Chung. "The SubT Challenge allows for a very wide aperture of approaches to address the problem at hand."

DARPA has a history of using competition to seed innovation. In 2004 and 2005, for instance, it hosted its Grand Challenge to accelerate the development of autonomous vehicles. Thanks in large part to that competition, automakers are preparing to launch their first driverless cars as early as next year. DARPA hopes the SubT Challenge will be a similar catalyst.

"The idea is that human supervisors will be aboveground somewhere, away from the underground mission. So, we must have absolute autonomy."

-KOSTAS ALEXIS, UNIVERSITY OF NEVADA, RENO

"A challenge is a really great way to pose an audacious problem and offer it up to the world to bring together a diverse pool of innovators and see what they bring to the table," continued Chung, who said SubT technology could one day assist not only soldiers in combat, but also civilian first responders and perhaps even commercial entities in industries such as mining.

The SubT Challenge comprises three "circuits" during which competitors will test and demonstrate novel robotic solutions. The first, the Tunnel Circuit, took place in August at a mine outside of Pittsburgh, Pa. The second, the Urban Circuit, will take place in an urban underground environment—a subway, perhaps, or a sewer—in February. The third, the Cave Circuit, will take place in a natural cave environment in August 2020. A fourth and final event will integrate all three subdomains in August 2021.

To achieve the competition's GEOINT objectives and win up to \$2 million, competing teams must successfully execute on four pieces of the subterranean puzzle: autonomy, perception, mobility, and networking.

Because underground environments can be dangerous for humans, autonomy is especially important, according to Kostas Alexis, director of the Autonomous Robots Lab at the University of Nevada, Reno (UNR).

"The idea is that human supervisors will be aboveground somewhere, away from the underground mission. So, we must have absolute autonomy," said Alexis, whose team— Team CERBERUS, comprising UNR; Swiss university ETH Zurich; the University of California, Berkeley; Sierra Nevada Corporation; and Swiss company Flyability—was one of 11 that competed in SubT's Tunnel Circuit. "Because an underground network of tunnels can be kilometers long, the systems must be able to integrate and operate on their own in very large-scale environments."

Team CERBERUS, which placed sixth in the Tunnel Circuit, has designed a quadruped robot about the size of a dog. When it enters an underground environment, the robot will carry on its back a drone it can deploy if it encounters unnavigable vertical or multi-level environments. Thanks to their autonomy, the robots will be able to determine the appropriate time to deploy their drone companions. Eventually, the robots will be able to exchange and achieve what's known as collaborative autonomy.

"Robot A needs to be able to share maps with Robot B so as to be able to make intelligent decisions as a team," Alexis explained.

A prerequisite for autonomy, of course, is perception.

"[Present-day autonomous systems] operate well in environments that are well-lit, wellstructured, and with good features. That's not what an underground environment is," Alexis continued. "An underground environment can be simultaneously texture-less and dark. And if there's a potential threat, it might even be full of smoke. That challenges the ability for the robot to know where it is and to map the environment accurately, which in turn challenges its ability to operate autonomously."

To solve perception challenges, Team CERBERUS uses a multi-modal sensor fusion package that includes a camera, LiDAR, thermal vision, and a gyroscope for inertial navigation. Later, it also plans to add radar.

The area in which Team CERBERUS has swung for the fence, however, is mobility.

"The question is: How can you make a unified robotic solution that can be deployed in a variety of situations?" asked Alexis, whose robot features jointed legs that are designed to function in a variety of underground environments, from mines littered with rocks to subway stations full of stairs. "With legged systems, you have dexterity over different types of terrain."

Another team, Team Explorer, took a similar yet different approach. Comprised of roboticists from Carnegie Mellon University and Oregon State University, it built two autonomous ground vehicles designed to work in tandem with two drones. Instead of legs, however, its modular vehicles feature large, all-terrain wheels that roll instead of step over obstacles.

"We used big, knobby tires that are actually motocross racing tires for dirt bikes, and that gave us the traction and mobility we needed," said Steven Willits, lead test engineer for Team Explorer, which placed first in the Tunnel Circuit thanks not only to its superior mobility, but also its approach to the challenge's final requirement: networking.

"Each of our ground robots is a communication node in and of itself, but then we also have them drop Wi-Fi nodes at strategic locations," continued Willits, who said one ground robot can be sent deep into a mine to map it autonomously while another robot follows behind to build a local communication network. "That way, when the first robot comes back into range, we're able to receive all the information it stored while it was roaming around."

Whether you're talking about automation, perception, mobility, or networking, the goal is to facilitate mapping in the absence of GPS. For DARPA, however, the underground is as much about relative as absolute location.

"The SubT Challenge focuses on what we like to call actionable situational awareness," Chung said. "What that

"In places where we don't have access to GPS and other ways to geo-rectify the data that we have, it's a severe limiter. One of those places is the underground. The SubT Challenge allows for a very wide aperture of approaches to address the problem at hand." -TIMOTHY CHUNG, DARPA



IMAGE COURTESY OF DARPA

means is: We want to move beyond just having knowledge of the layout or the environment by itself and toward understanding how it relates to the mission at hand. In the context of the SubT Challenge, it's about not only having a map—which in and of itself is hard to obtain—but also being able to use that map to provide insight into, for example, where artifacts are located so that emergency responders or incident commanders can make decisions based on the location of survivors, hazardous areas, and things of that nature."

Despite their myriad differences, urban and underground environments in that respect are exactly the same: Whether the Army of the future faces adversaries in the concrete crevices of Dhaka, the cosmopolitan streets of São Paulo, the metros beneath Europe, or the mountainous caves that lurk below Afghanistan, GEOINT is about more than coordinates. It's also about context. And thanks to efforts like OWT and the SubT Challenge, context will soon be possible in even the most complex places.

Concluded Tilton, "Having knowledge about what the world actually looks like makes our warfighters more effective wherever they engage."

To inspire new approaches to mapping and analyzing underground spaces, DARPA created the SubT Challenge, with a potential prize of \$2 million.

transforming traditional analysis

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Digital natives bring a new perspective to the GEOINT workforce BY ANDREW CONNER

TRAVELING THROUGHOUT NORTHERN AFRICA IN APRIL

▼ 2017, Katie McGaughey and her colleague were tasked with estimating crop yields for the upcoming harvest of wheat and barley in Morocco and Tunisia. While this type of trip is common for McGaughey, a senior crop assessment specialist with the United States Department of Agriculture's (USDA) Foreign Agricultural Service, the way she and her colleagues collected data on this excursion represented a significant shift.

"We were trying to more accurately forecast wheat area in Morocco at an earlier date than we have been able to in the past," McGaughey said. To accomplish this, she and her colleague used a smartphone-based app developed by the National Geospatial-Intelligence Agency (NGA) called MAGE (Mobile Awareness GEOINT Environment). MAGE allowed McGaughey to collect crop area data in the field then seamlessly sync it to the cloud when she regained internet connectivity.

"The crops were in the reproductive stage, and we were able to get pretty good area estimates using MAGE," she said. "We published our results in May and at the end of the season, we were within a 1% margin [of the official statistics]. We were able to do that four months prior to the harvest, which is a really big deal. For a remote sensing classification, it was about the best we could have hoped for."

From left: Former U.S. Army Staff Sergeant Aljune Lerio, Katie McGaughey, Crop Assessment Specialist at USDA, and Benjamin Foster, Technical Lead, GEOINT Services Capabilities at NGA, took part in the "Digital Natives Empowering the GEOINT Enterprise" panel discussion at GEOINT 2019.

McGaughey also noted that their data collection in Tunisia was successful, coming within a 6% margin compared to official statistics.

A MATTER OF PRACTICALITY

McGaughey's story is one of many in which federal employees who have grown up or spent their formative years with access to modern technology are using that lens to improve their capabilities and performance in the workplace. One term often used to describe people such as McGaughey is "digital native."

Notably used by John Perry Barlow, founder of the Electronic Frontier Foundation, in his 1996 paper "A Declaration of the Independence of Cyberspace," the digital native children of the 1980s and 1990s are the analysts, officers, and engineers of today.

However, while digital natives are often thought of as members of the millennial generation or even Generation *Z*, it's important to note that age is less important than mindset when considering what digital natives can bring to their organizations.

Jeremy Boss, an imagery analyst in the Asia Pacific Office and a member of the Project Sagittarius innovation team at NGA, considers himself a "digital immigrant"—a term used to describe people who may not have grown up with technology but are regardless comfortable with it. "I was

"The analysts will teach the developers about the mission, the national security priorities, and workflows—and the developers will then respond with improvements that will create efficiencies." —ADAM MARLOWE, NGA

born in the Xennial phase," explained Boss. "I had my first computer in high school, so I didn't exactly grow up with it, but I definitely came to it at a formative time."

When it comes to innovation, the exact terms used to describe the individuals bringing new ideas and processes to the analytic environment aren't nearly as important as the value the mindset provides.

"One of the characteristics of people in our area of the spectrum is a deep practicality," Boss said. "Everything technology for me is about practicality: 'What is the practical application I can get out of it?' And I think [that approach] has really helped us communicate to people who might be late adopters."

Boss pointed to a tool he works on as part of Project Sagittarius called Dragon Drop.

"It's analyst-created and analyst-driven," he said. "It is technology and it is automation, but it has deep practicality built into it. It leaves the expertise in the hands of the subject matter experts and the technology works around them. That focus has really been key to getting people to like the tool and adapt to the tool and use it. Whether you're a digital native or not, we're putting you in a position where this helps you on a day-to-day basis."

McGaughey echoed Boss's comments when discussing how MAGE's success in estimating crop harvests helped illustrate that the technology had practical value to USDA's mission.

> "We're trying to get the best area and yield estimates for 15 commodities for the 140 countries that we cover, and if MAGE helps us do that, that's great," she explained. "By having these results, we've been able to point to that success and scale up that success because now we've done it in maybe 15 countries for dozens of crops."

> Aljune Lerio, a former staff sergeant in the 91st Civil Affairs Battalion who is now transitioning

to an officer role, had a similar experience incorporating MAGE into his work. During a terrorist event in Burkina Faso in 2018, Lerio and his team used MAGE to provide much-needed information about what was happening on the ground when other communication sources were unavailable. Lerio said that getting buy-in to use a mobile app like MAGE required him to evangelize it to skeptics, and being a digital native helped him make the case.

"The traditional processes are important because they have been proven effective—maybe not efficient—but effective," Lerio said. "I knew the mobile app was something that our advanced forces could use, so every opportunity I had to speak about it or highlight it, whether in training or operations or to a higher command, I took that opportunity."

Instead of replacing or changing traditional methods, MAGE helped Lerio's team enhance those methods.

"When you go through the foundational, traditional way of doing things, moving on to more advanced things gives you an appreciation of how fast things could be," Lerio said. "There has to be the understanding of the human terrain and the human element of the things we're doing [whether you're using traditional or new methods]. And then when you have that connection or human network, and you bring new ideas to it, the ball keeps rolling."

A TEAM EFFORT

One of the key elements of successfully incorporating new technologies at organizations like USDA, NGA, or the military is working with others—not just higher-ups to gain buy-in for new, innovative projects, but also peers and colleagues to conceptualize and develop new ideas.

"A focus on research teams is especially important in areas of emerging technology," said Adam Marlowe, a senior GEOINT officer with NGA's Office of Weapons and Counterproliferation. "It's really underpinned a lot of the success that I've seen, and it goes back to giving time to the analysts and the other work roles to get together and learn from each other and iterate together. The analysts will teach the developers about the mission, the national security priorities, and workflows—and the developers will then respond with improvements that will create efficiencies."

Matthew Larsen, an imagery analyst in NGA's Middle East and Southwest Asia Office, noted that this type of collaboration can and should involve everyone, even people who might not consider themselves digitally proficient.

"We can benefit by having even those who aren't technologically adept [in the conversation]," Larsen said. "By getting digital natives and people who are more open to technology involved, we're examining the potential of what technology can bear by developing a human-machine hybrid and integrating it all together. That creates the potential for breakthroughs that can help us drastically streamline some cases or workflow, develop new tradecraft, produce new insights, and come up with answers that we wouldn't have been able to before."

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-MELISSA A. PLANERT, NGA

"Some of the biggest successes I've seen were in offices where non-digital natives allow that space and time and provide that encouragement to help analysts iterate and innovate on the tools they have," Planert said. "We've certainly seen the whole spectrum from both digital natives and non-digital natives in terms of moving into technologicallyaugmented workflows for our analysts."

> As more young professionals who grew up with mobile devices in hand enter the workforce, some amount of change is inevitable. But the questions are: How much will occur and how quickly?

"I think there will be a real paradigm shift in the way we think about NGA's role, and the way we think about intelligence as a practice," Boss said. "We've been developing these technologies and adapting them to the traditional paradigm. I think that in the next five, 10, 15 years, you're going to see all that change. Particularly the increasing use of artificial intelligence and the increasing use of the mountains of geotagged information that is now out there, I think that's going to cause a dramatic shift in the practice of NGA. [Digital immi-

grants and natives] are really at the forefront of that, and we are the ones that are going to shape what that new environment, that new context, looks like."

While Marlowe agreed with Boss, his view of the future is a bit more tempered.

"I believe that new paradigm will come with an understanding of the inherent constraints of these new technologies," he said. "Maybe we will wonder less about the right use cases for technology, and we'll be quicker to apply new technologies in certain cases. And there will certainly be a leading edge. I think that is in the process and that won't stop. But presently, we're still learning a lot about how to apply things like AI and deep learning, especially for image object recognition, ATR, computer vision, and these things."

Planert said she also sees the role of technology at NGA expanding, as interest in and experience with new technologies becomes a more significant element of the hiring process.

"We're currently seeing gains that can only grow," she said. "As we hire new people, we're looking for the traditional skills that make a great analyst—the ability to think creatively and critically, understanding of geopolitical context, and good communication and teaming skills—but also more and more we're requiring some technological capability. [That could be] in the realm of statistics or data coding, or GIS skills for our imagery analysts. We're expanding the envelope in terms of the types of skills we're seeking in order to encourage more digital natives to join us."

Whether the changes that occur are large and swift, or more incremental, it is clear that the future of analysis, whether at NGA, other federal organizations, or in the private sector, will be heavily influenced by digital natives.

Supporting the FULLIO GEOINT Workforce

Since 2004, USGIF has awarded more than \$1.3 million to students with aspirations in GEOINT.

N 2019, USGIF AWARDED \$130,000

in scholarships to 25 individuals studying geospatial intelligence (GEOINT) and related topics. This is the largest annual amount USGIF has distributed to date, thanks to the contributions of USGIF Organizational Members. Since the USGIF Scholarship Program began in 2004, the Foundation has awarded more than \$1.3 million to students with aspirations in GEOINT.

USGIF offers \$5,000 scholarships annually to outstanding doctoral candidates, graduate students, and undergraduate students as well as \$2,000 scholarships to graduating high school seniors.

USGIF MEMBER-FUNDED AWARDS

Accompanying the 2019 USGIF awards are three scholarships funded entirely by USGIF Organizational Members:

- > The first ever \$15,000 Dun & Bradstreet Geospatial Data Science Scholarship, awarded to a student pursuing a Master of Science or Ph.D. in data science who is focused on solving large-scale, location-based problems.
- > The fourth Ken Miller Scholarship for Advanced Remote Sensing Applications sponsored by Riverside Research, which awards \$10,000 to a graduate student studying remote sensing who plans to enter the defense intelligence workforce.
- > The second Reinventing Geospatial Inc. (RGi) Scholarship for Geospatial and Engineering, a \$10,000 scholarship awarded to an undergraduate student pursuing engineering and geospatial disciplines.

THE DUN & BRADSTREET GEOSPATIAL DATA SCIENCE SCHOLARSHIP Yaneev Golombek University of Colorado, Denver

University of Colorado, Denver Civil Engineering Golombek received his bachelor's degree

in environmental studies from the University of Michigan and his master's degree in Geographic Information Science from the University of Denver. He currently works as a GIS projects and applications lead at Merrick & Company, developing scopes and implementing projects related to data development, asset management, and data modeling. His doctoral research is focused on utilizing LiDAR and remote sensing applications for urban transportation.

THE KEN MILLER SCHOLARSHIP FOR ADVANCED REMOTE SENSING APPLICATIONS Kris W. Erickson Northeastern University Geospatial Services

Erickson is an Imagery Intelligence Officer in the United States Army Reserve. With a background in engineering and more than 14 years of experience as an Army reservist, most of which as an all-source intelligence analyst, Erickson is passionate about automation and the fusion of multi-INT sources. After long being an avid consumer of satellite imagery and map data, he decided to specialize in GEOINT. While managing a team of Army geospatial analysts, his perspective as a mechanical engineer fueled his interest to learn more about remote sensing hardware and the breadth of collection techniques.

THE RGI SCHOLARSHIP FOR GEOSPATIAL AND ENGINEERING Kevin Mercy

University of Southern California Archaeology

Mercy is pursuing a B.A. in Archaeology with minors in Geospatial Intelligence and

Computer Programming. Through his work at USC, focused on the visualization and exploitation of 3D geographic data, Mercy was hired as a summer intern at The Aerospace Corporation, where he assisted in the development of an internal web service platform for aerospace imagery. Previously, Mercy has worked at MIT's Lincoln Laboratory and as a field archaeologist in Guatemala and Catalina Island.

DOCTORATE

Duncan Eddy Stanford

University Aerospace Engineering Eddy is completing his Ph.D. in

the Intelligent Systems Laboratory at Stanford while working full-time as the operations lead at Capella Space. He received his bachelor's degree in mechanical engineering from Rice University and his master's degree in Aerospace Engineering at Stanford. Eddy is passionate about building more responsive and resilient satellite systems. His research focuses on optimizing task planning for Earth-observing constellations to both improve intelligence collection and to minimize the downtime caused by collision avoidance maneuvers.

Christopher Olayinka Ilori Simon Fraser University Geography Ilori's research focuses on the

remote sensing of optically complex waters, using physics-based inversion algorithms to provide estimates of bathymetry, substrate composition, and water quality information. Ilori is a UN Global Pulse Data Fellow and assists UN Habitat with population counts of informal settlements from satellite data. He holds a BSc degree in Geography from Obafemi Awolowo University in Nigeria and an MSc degree in Sustainable Environmental Management from the University of Greenwich in the UK.

Rachel Jones Missouri University of Science and Technology Geological and Geophysical Engineering

The focus of Jones' research is humanitarian geospatial engineering using remote sensing data fusion methods including photogrammetry, SAR, and magnetometry for topographic hydrological investigations in post-civil war Uganda. She is involved with a variety of causes, including counter-human trafficking geo-analytics for missing and exploited persons. Jones is a Benedictine oblate (lay associate) of Our Lady of Clear Creek Monastery and has a german shepherd named Sasquatch.

Emilio Mateo The Ohio State University Geography Mateo received his bachelor's degree

from the University of Michigan in Environmental Science with a focus in Geographic Information Science and a minor in Statistics. He spent a year working in multiple roles with the Student Conservation Association, first as a park guide, then as an environmental educator, and finally as a GISc and field mapping specialist. Mateo received his master's degree from the University of Denver, and at The Ohio State University is studying how ongoing changes in glacier coverage impact water quality and quantity. He is combining hydrological fieldwork and geospatial modeling to conduct research on glacial water resources in the Cordillera Blanca, Peru.

Stephanie Mundis University of

Florida Geography Mundis is working on applying spatial data and geostatis-

tical analyses to identify and explain variation in the development of insecticide resistance in mosquitoes across multiple spatial scales. She earned a bachelor's degree in Geography and Anthropology from the University of Illinois at Urbana-Champaign before going to New Mexico State University to pursue parallel degrees in Geography and Biology. While at New Mexico State, she completed a thesis project on the current and potential future distributions of *Aedes aegypti*, a disease-vectoring mosquito species.

GRADUATE

Madeleine Guy University of Maryland, College Park

Geospatial Intelligence Guy earned her bach-

elor's degree in Geographical Sciences with a minor in Global Terrorism Studies from the University of Maryland, College Park (UMD). She is currently working full-time in the Department of Geographical Science while pursuing her master's degree in Geospatial Intelligence at UMD. During her undergraduate studies, she interned at the National Consortium for the Study of Terrorism and Responses to Terrorism, where she developed a passion for researching the spatial predictability of terrorism.

Scott Howard Colorado State

University Computer Engineering Howard received his

bachelor's degree in Computer Science from Rowan University in 2014. While finishing his M.S. in Computer Science, also from Rowan, he developed applications for mission critical systems for various branches of the U.S. military. Among these programs was a protection system for armored vehicles that processed geospatial data reported from remote sensors to autonomously engage incoming threats via onboard countermeasures. Howard's research interests include long range, energy efficient communications for remote sensors.

Jong Su Kim University of

Southern California Human Security and Geospatial Intelligence Kim is an Air Force

ROTC cadet majoring in International Relations while concurrently pursuing a master's degree in Human Security and Geospatial Intelligence. His research focuses on utilizing coarse-resolution satellite imagery for human rights monitoring. Kim spent the summer interning with the U.S. State Department's Humanitarian Information Unit, where he created cartographic products and supported Secondary Cities, the department's field-based geospatial initiative. Next summer, he plans to commission in the U.S. Air Force.

Zach Little University of Alaska, Fairbanks *Geosciences* Little is pursuing his M.S. in Geosciences with a concentration

in Remote Sensing and will defend his thesis in May. He received his B.S. from the University of West Georgia in Human Geography with a minor in GIS in 2014. His current geospatial interests are using time series stacks of Copernicus Sentinel-1 SAR data to monitor crop growth and harvest as well as to predict yield in Kenya. Additionally, Little is delineating crop type by assigning a threshold based off temporal signature and cross-referencing it with crop data layers provided by the USDA Foreign Agricultural Service.

Rebecca Malone Georgetown University Security Studies

Malone holds a bachelor's degree from American

University in U.S. Foreign Policy and National Security. She currently works at the Department of Defense as a geospatial analyst. Her graduate thesis is about the impact of Brexit on paramilitary violence in Northern Ireland, and she plans to use GIS to analyze the geographic trends of political violence in the region. She is interested in using GIS to better understand international conflict and to support national security.

Brett Ruether University of Utah

Geography After graduating from the University of Utah with a bachelor's degree

in Anthropology and Integrative Biology in 2012, Ruether worked for six years as a field biologist for various environmental consulting firms throughout the American West. Upon returning to his alma mater, his research has focused on understanding climate-conflict links, humanenvironment interactions, and wartime governance and land use patterns. Ruether is currently conducting a geospatial analysis of the strategic role of agriculture throughout the conflict in Syria using remote sensing data, social media analytics, and armed conflict databases.

Kylie A. Tokar University of Maryland, College Park Geospatial

Geospatial Information Sciences

Tokar's interests in GEOINT exist at the intersection of environmental science and emerging open-source technology. While working on her bachelor's degree in Geography at the University of South Carolina, Tokar applied her GIS skills to mitigating wetlands at construction sites with the Department of Transportation, mapping utilities and weapons on a National Guard base, and orthorectifying aerial imagery of coastal landscapes. While pursuing her graduate degree, Kylie also works full-time as a geospatial data scientist for Maxar, providing database management, spatial statistics, and cartographic visualization to federal customers.

UNDERGRADUATE

Alexander Chrvala University of Mary Washington Geography In April, Chrvala presented a poster

on a proposed interstate highway at the American Association of Geographers annual meeting in Washington, D.C. This summer, he worked as an intelligence analyst intern at the Department of Defense. There, Chrvala gained both valuable practical skills and a network of peers and colleagues. Moreover, the internship enabled him to apply his interests in national security and geopolitical issues.

John Michael Jacobson Arizona State University Electrical Engineering Jacobson recently

joined the Arizona Air National Guard, where he works with surveying and geographic information systems as an engineering assistant and has the opportunity to learn about and contribute to GEOINT. He highly values accurate and detailed information, especially when military decisions made based on GEOINT can have significant amounts of money or even lives on the line.

Mikhail Kaminer University of Colorado, Denver Geography Being born in

Russia and then immigrating to the U.S. fostered Kaminer's fondness for the human reality and his passion for urban development, specifically in the field of transportation. He is pursuing a B.A. in Geography with an emphasis in Urban Planning and a GIS Certificate, along with a Spanish minor. Kaminer plans to one day guide a transition to more effective public transit systems and hopes to cultivate a commute that will not hinder human comfort.

Brandon Staple University

of Colorado, Denver Computer Science and Biology

Staple's computer science interest is in developing resilient machine learning networks to increase target classification accuracy in critical, real-world GEOINT applications. He has interned at the National Reconnaissance Office, Google, and the National Security Agency. His goal is to serve the GEOINT Community by developing next-generation computer capabilities to assist analysts in performing more efficient and accurate intelligence assessments of complex, multi-source datasets.

Sarah Marie VanSchoick University of Florida Geography VanSchoick specializes in tropical

cyclone rainfall vulnerability. In addition to her degree in Geography and certificate in GIS, she is seeking a minor in Anthropology. As chair of the Undergraduate Student Affinity Group of the American Association of Geographers, she addresses the need to incorporate undergraduates into the culture of graduate academia and to prepare geospatial scientists for the workforce. VanSchoick is interested in using GIS and Python to assess vulnerability to natural disasters.

GRADUATING HIGH SCHOOL SENIOR

Dean Alvarez Strawberry Crest High School; now attending Cornell University

Computer Science During high school,

Alvarez took part in the International Baccalaureate diploma program. Outside of school, his interest in computer science drew him to learn subjects such as cybersecurity and AI. This self-study led Alvarez to two internships at CACI, where he worked on research projects and learned more about computer vision and its applications to GEOINT.

Trevor Burke St. Mark's School of Texas; now attending Southern Methodist University Mechanical

Engineering and Mathematics Burke is a member of the University Honors Program and a Hunt Leadership Scholar. Last summer, he participated in a NASA geospatial research internship. He hopes to further his GEOINT interest by earning a master's degree and Ph.D. in engineering with an emphasis in GEOINT. His career goals include the design and operation of aerospace vehicles and their integrated subsystems. An Eagle Scout with 23 Palms, Trevor has earned all 139 Merit Badges.

Alyssa Cassano Fairfax High School; now attending James Madison University *Geographic Science*

Cassano first learned of geospatial science though a dual enrollment class with James Madison University. Her final project illustrated how the population of counties in northern Virginia has risen in the past 20 years. The project placed second in The Story Behind the Map: 2019 Virginia AGO Map Competition. Cassano is majoring in Geographic Science with a concentration in Applied Geographic Information Systems.

Erin Dowdy Edwardsville High School; now attending University of Illinois, Urbana-Champaign

Computer Science and Geography & GIS

Dowdy is primarily interested in the technology that goes into GIS and remote sensing, but also enjoys the human and cultural aspects of geography. She is excited to learn more about the subject and its uses in college and looks forward to getting to know USGIF and the communities it serves.

Sierra Taylor Richmond Heights High School; now attending John Carroll University Computer Science

Taylor is from Cleveland, Ohio, and graduated second in her class. She is excited for the opportunity to learn more about how to apply computer science to GEOINT, and plans on studying how it can help others. Taylor is also interested in developing new geospatial technologies to enhance disaster response and relief. It is her lifelong dream to work in the STEM field. ^(C)

membershippulse who we ARE

SAIC: Creating an Industrial Ecosystem

Q&A with Michael LaRouche, executive vice president and general manager for National Security

What is SAIC's role in geospatial intelligence (GEOINT)? Fundamentally, SAIC is a technology integrator and mission enabler. We are large enough to engage in all elements of GEOINT, which includes the Intelligence Community (IC), warfighters, policy-makers, and partnerships with industry and universities across the country. But we are also small enough to move at rapid speed. SAIC leverages its position in the GEOINT Community to integrate ideas and technologies across different areas to deliver results faster.

Michael LaRouche

How do SAIC's capabilities contribute to the GEOINT Community? We leverage technological innova-

tions and our broad network connectivity across the GEOINT

Community to broker together technological innovation from smaller industries with the military and the National Geospatial-Intelligence Agency (NGA). SAIC was fortunate enough to partner with NGA's Source Transformation division to create an industrial ecosystem that allows new, innovative partners to provide applications. We helped create an ecosystem through which creative partners can produce applications that are warfighter-centric and meaningful. Applications are evaluated and tested by SAIC, and NGA quickly adopts those that have high relevancy.

How does SAIC leverage USGIF Membership to enhance its services for customers? SAIC consistently adopts, integrates, and innovates technologies invented by other companies while still doing some inventing of our own. USGIF is one of the leading organizations that help us. The Foundation offers opportunities for us to be aware of new challenges within the GEOINT Community. It also allows us to interact with traditional and nontraditional partners so we can gather more insight to affect our technological innovation and our integration of other technologies to support a focused application.

How long has SAIC been involved with USGIF?

We're very proud that we were a founding member when USGIF was established nearly 16 years ago. As a U.S. government integrator, we saw the Foundation as an excellent platform for us to bring all we're doing across the community into focus. By leveraging everything, from the large to small initiatives, we've been able to use USGIF resources to bring forward what we do. On a large scale, you have the GEOINT Symposium, which brings the community together. But there are also smaller events, like GEOINTeraction Tuesday and the GEOINTegration Summit, that create opportunities for us to engage in a more intimate setting to learn and exchange ideas.

What excites you about the future of GEOINT and SAIC? The community is dealing with exponential data sources. The number of places where we can get data that affects GEOINT is growing exponentially. We are also dealing with exponential data availability. And so, this exponential challenge is something SAIC continually works to address. It's easy to get trapped in what I might call "continual reorientation and observation" because, at this speed of change, we continuously have to reorient and spend our time observing. SAIC invests in analytical technology, IT modernization, application modernization, etc. We want to support investments in advanced visualization techniques, build partnerships across industries, and remain focused on the bigger picture. Ultimately, we want to take action and to affect mission outcomes.

PixElement: 3D Tools for Faster, Smarter Decision-Making

Q&A with Benjamin Vander Jaqt, co-founder and president

What is PixElement's role in the geospatial marketplace? We empower individuals, companies, and agencies to leverage their existing imagery assets to answer new questions. For example, in the commercial construction sector, aerial imagery was historically used most often for

inspection. It answered basic questions like, "Are they making progress?" or "Have they finished the roof?" But now, with those exact images, they can quantify the progression on a construction site, and, more importantly, mistakes can be explained. For example, "Why was that transformer installed 13 centimeters higher as compared to design and how close is that vegetation to the right of way?" Such capabilities extend to geospatial intelligence (GEOINT) as well. In intelligence, questions often need to be answered quickly with whatever imagery is available, and our software is what makes sense of it all.

What are some of the primary industries you serve?

As a startup, our initial focus was mainly in construction, mining, and surveying, but we quickly discovered that accurate 3D data is an essential component of GEOINT. Now, we represent anyone looking to extract high-accuracy 3D information from imagery. Our algorithms work with close-range drone imagery, aerial, and satellite platforms. As a result, we have a diverse set of customers all over the world. At the highest level, the primary function of our software isn't processing images, it's to enable discovery and foster collaboration throughout the enterprise—from analysts and engineers to crucial stakeholders and policymakers.

What services do you provide? PixElement is a commercialoff-the-shelf (COTS) software company serving both industry and government. With imagery as the input, we provide incredible tools that allow for 3D and 4D modeling of objects, job sites, and battlespace with unprecedented accuracy. We release new versions of our software multiple times a month and continuously add new functionalities based primarily

Benjamin Vander Jaqt

3D building measurement and analysis using PixElement software.

on user feedback. We actively engage with our users to figure out better ways to solve their complex problems.

What makes you stand out within the GEOINT Community? We are passionate about the value of time, and we developed our image processing software with that in mind. Every feature, tool, and process has been built to accelerate the decision-making timeline.

From a technical standpoint, our 3D workflows and technology infrastructure were designed from the ground up to leverage the scalability of the cloud (i.e., it is cloud native). There is a significant push within the GEOINT Community to modernize legacy applications by moving them to the cloud, but if those applications were designed to live and operate in a single box, what good is it if you have 10,000 boxes available?

How has USGIF membership benefited PixElement? The National Geospatial-Intelligence Agency was our first government customer and opened our eyes to the world of GEOINT. We decided to learn more about the community, its various constituents, and the daily problems they encountered that we could potentially solve; this led us to USGIF. Membership in a community like USGIF is all about engaging with other people. As first-year members, we have already met many different individuals, companies, and agencies. It was a real eye-opening experience the first time we walked through the doors at GEOINT 2019, and the Symposium helped us identify where we fit in as a company.

What are your hopes for the future of PixElement? We're interested in working with new organizations like the National Reconnaissance Office and the U.S. Air Force to solve problems that are unique to their respective missions. For example, leveraging the highresolution 3D models we generate from EO imagery to improve the accuracy and interpretation of SAR data, which can be collected in all types of weather conditions and has numerous GEOINT applications.

Things are changing quickly in this industry. Sometimes, as a small business, it's frightening because you wonder what the next 10 years have in store. But what excites us most and keeps us going is discovery. There's not a week that goes by when we aren't discovering a new feature, or a more efficient process, or a new problem to solve. And that gives us the confidence to embrace change and the challenges that come with it.

Competency and Teamwork

Q&A with Steven Truitt, Government and Platform Operations, Descartes Labs

After studying Aerospace Engineering, Steven Truitt had two choices: work on Wall Street or work on satellites. He chose satellites because it sounded more fun. Now working at Descartes Labs, Truitt started his career in realtime operations and quickly became interested in every aspect of the business, from space-based sensors to transmitting data to organizing personnel for the purpose of accomplishing complex goals.

What challenges have you encountered in GEOINT? One of the biggest challenges we face in this community is the strong legacy of how things have been done in the past and its proven effectiveness. Today's technologies and volumes of information require an entirely new way of doing business. However, the transition from previous solutions that function but do not scale to a new way of operating is quite challenging. There are acquisition issues, policy issues, and simply just ways of thinking about problems that need to change. These are relatively difficult things to alter and can't be changed overnight. So, one thing I have encountered is that being able to prove something is possible is usually not always sufficient to make it happen. There are very real inertial changes that have to occur first.

What is your role at Descartes Labs?

At Descartes Labs, we aim to create a digital twin of the world and the first step in doing so is to have large-scale

Mineral and land classification in Santa Fe, N.M.

Steven

Truitt

measurement and observation that is easily accessible and intuitively usable in a variety of contexts. We are currently building out a hyper-scale cloud environment that supports that type of measurement and observation work to go toward long-term understanding and comprehension.

I run our government business and our platform engagements with customers. On the government side, I make sure we deliver on our obligations and bring novel technologies to problems within the government space. In my platform role, I ensure we are maximizing relationships with governments, NGOs, academics, and other bright people in the field. People who are conducting large-scale analysis use our tools to provide a high-quality experience in a variety of forms, from technical support to coaching and transformation training.

What advice do you have for aspiring GEOINT professionals? Learn as much about the world and how it works as possible. Be curious and learn to think from others' perspectives. Understand and use the difference between complication and complexity when interpreting and communicating. Try to present ideas in a way that makes people question their assumptions in addition to simply conveying facts. Geospatial work can be illuminating when done with care, or it can be misleading and dangerous when it is not.

What inspires you about the future of GEOINT?

The growth of GEOINT capabilities in the commercial sector is exploding and this is really inspiring and optimistic for the future. There is a lot of injection of capital and brainpower into solving fundamental technology problems. When that translates over to the intelligence and defense mission, it's going to reshape some of the ways these large organizations do business.

What led you to join USGIF as an individual member? My main reason for joining USGIF was to take advantage of the GEOINT Symposium and some of the local meetings in the DMV area. These are good venues that bring together people who represent all sides of the value chain. USGIF provides a forum to have conversations that are fairly frank without a lot of corporate positioning or other internal politics taking control. The people attending these events often focus on meaningful technical issues.

How has a USGIF membership helped your career?

GEOINT is interesting because it is extremely complicated and tied to the real world. What that means is no one person can solve any one problem. At best, we all approximate portions of it. USGIF connects people who are all working on related issues. This is definitely an industry where "going it alone" is not going to get you very far. By taking advantage of the networking and training capabilities USGIF offers, we are able to talk to other professionals in the field. (

USGIF's 2019 EdGEOcation Giving Campaign is underway! With your help, our goal is to raise \$12,000 by Jan. 1.

- Sending a giant map of North America to schools across the country
- Sponsoring STEM events and judging science fairs
- Collaborating with USGIF Organizational Members and Partners to provide hands-on learning activities
- And more!

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READING LIST

Archaeology from Space: How the Future Shapes our Past

By Dr. Sarah Parcak Space archaeology is a growing field sparking extraordinary discoveries about ancient civilizations across the globe. TED Prize winner Parcak portrays the evolution, significant findings, and future potential of satellite archaeology. Her stories take us back in time, across borders, and into the everyday life of ancient humans to show how the lessons of the past can create a vibrant future.

ARCHAEOLOGY FROM SPACE

HOW THE FUTURE SHAPES OUR PAST

SARAH PARCAK

NOVACENE

The Coming Age of Hyperintelligence

JAMES LOVELOCK originator of the Gaia theory

Novacene: The Coming Age of Hyperintelligence By James Lovelock

Lovelock theorizes a future in which humans and AI work together to help the Earth survive. "Novacene" is a term that refers to new beings emerging from existing artificial intelligence systems. The book posits that AI systems will think 10,000 times faster than the average person and will regard us as we regard plants. Lovelock argues that these AI systems will also be as dependent on the health of the planet as we are; therefore, humans and hyperintelligent beings will need to work together as partners.

USGIF EVENTS CALENDAR

NOVEMBER 18-23 GEOINT Community Week Northern Virginia & New York City

Nov. 19-20 Machine Learning & Al Workshop, Springfield, Va.

Nov. 19 GEOINTeraction Tuesday, Springfield, Va.

Nov. 21-22 Geography 2050, New York City

> Nov. 23 GEOGala, Reston, Va.

FEB. 25-26 Small Satellite Workshop Springfield, Va.

APRIL 26-29 GEOINT 2020 Tampa, Fla.

Map: Exploring the World

This collection brings together more than 300 fascinating maps, from the birth of cartography to the cutting-edge digital era of the 21st century. The maps, uniquely organized in complementary and contrasting pairs, reveal how the history of our attempts to make flat representations of the world is full of beauty, ingenuity, and innovation. The book also reflects upon the many reasons people make maps, such as to navigate, record human activity, establish control, and plan military campaigns.

Cesium announced **BONNIE BOGLE**, formerly of Mapbox, as its new COO. This news comes after Cesium broke away from Analytical Graphics Inc. to be a standalone company following a \$5 million investment.

Orbital Insight announced the addition of former NGA Director **ROBERT CARDILLO** and former USGIF CEO **KEITH MASBACK** as the founding members of its newly established Federal Advisory Board. Recently, Cardillo also joined the advisory board of Analytical Space.

JIM CARLINI succeeded Leidos chief technology officer **JIM CANTOR**, who assumed the role of chief of performance excellence and strategic partnerships.

General Dynamics IT promoted **KRISTINE GRINNELL** to Global Chief Information Officer and Chief Supply Chain Officer. She previously served as CIO and Vice President of Technology & Supply Chain.

SAIC announced **NAZZIC S. KEENE** as CEO effective Aug. 1. Keene, who most recently served as COO of SAIC, succeeds **TONY MORACO**, who retired after serving as CEO since 2013.

Former U.S. Secretary of Defense **JAMES N. MATTIS** was elected to General Dynamics' board of directors.

Mattis previously served on the GD board of directors from August 2013 to January 2017.

HawkEye 360 promoted **ROBERT RAINHART** to chief operating officer. Rainhart served as executive vice president of Engineering prior to his promotion.

MARTIN VAN RYSWYKIS was named Planet's new senior vice president of Product. In this role, he will be responsible for guiding product vision and strategies.

CHRIS SHANK joined Maxar as vice president of National Security Space, effective Sept. 9. As part of the Global Field Operations team, Shank will manage sales, business development, account management, and service delivery across Maxar's national security customer base.

The T-Rex technology incubator in St. Louis, Mo., announced its new Geosaurus geospatial center will be led by **MARK TATGENHORST**, who spent 33 years working at NGA.

JEFF TELLEFSEN was hired as the new Head of Product at Orbital Insight. Tellefsen will lead Orbital Insight's global product vision for its recently-launched GO platform.

perspective

THE EVOLVING GEOINT MISSION

A conversation with former astronaut and USGIF Interim CEO Steve Oswald

For the past year, USGIF Board Member Rear Adm. (Ret.) Steve Oswald has served as interim CEO of the foundation. During his career with the Navy and NASA, Oswald served as a tactical pilot, test pilot, space shuttle astronaut, and senior executive. As an astronaut, Oswald flew three space shuttle missions, piloting two missions aboard Discovery in 1992 and 1993, and commanding STS-67 aboard Endeavor in 1995. In 1996, Oswald was assigned to NASA headquarters as deputy associate administrator for space operations.

Before joining Boeing in 2001, Oswald served as deputy commander of the Joint Task Force for Computer Network Operations. At Boeing, Oswald served in a variety of leadership positions, including VP/PM of Boeing's space shuttle program and, more recently, VP/general manager of the Intelligence and Security Division of Boeing Defense Systems.

What have you learned about the GEOINT Community since being more involved at USGIF? The GEOINT Community has a rich history. We are a long way from getting a few images from an exquisite asset and using a light table to view them. Now that there are sensors everywhere, the community has many challenges that didn't exist 30 years ago, and much of that has to do with trying to sort out what's meaningful in terms of our national security mission. With the proliferation of commercial satellite constellations and UAVs, it's important to separate the wheat from the chaff—and to determine what's most useful when considering tools like AI and machine learning. USGIF is doing a great job of helping the community improve the tradecraft as the requirements of technology drive things in a different direction.

What are some other ways Earth observation has changed since your space shuttle missions in the '90s?

The availability of commercial remote sensing products is the most significant. Having those additional assets on orbit has served the national security community well, and it's allowed an entirely new business sector to flourish. The small sat revolution is putting affordable satellites in useful orbits to provide images that may not be as high quality, but the fact that they can be overhead more often on targets of interest is hugely beneficial. But this will make the data-crunching demand the community is facing that much more challenging.

Another area that is becoming more important is space traffic management, and someone has to take the lead on it. Small sats likely won't last as long as legacy systems and could lead to thousands of more pieces of space junk. While more is usually better, it doesn't come for free and sometimes the potential for collateral damage is overlooked during innovation. Operating in space is difficult enough—hopefully we won't make it harder.

How do you anticipate Earth observation will continue to evolve in the era of AI and high-performance computing? With so much GEOINT data out there already, the community doesn't have much choice but to embrace these technologies. It's not that different than when machines to help build cars were first introduced. Before those machines, folks were comfortable in the job they had attaching fenders to Fords. The GEOINT Community has a similar hurdle with those who have gotten comfortable doing what they've always done. But this is an evolution dozens of industries have undergone. The community must evolve; the challenge for leadership is to encourage people to embrace new technology and to pursue training opportunities.

What interests you the most about today's U.S. space programs?

Human space flight. Back in the Apollo days, the urgency wasn't really to get to the moon, it was to beat the Soviets in whatever they were pursuing. When President Kennedy laid out this challenge, NASA had a huge budget. And, because being first on the moon was deemed to be so critical, we weren't nearly as risk averse as we are today.

Human space flight was a government-run business up until the last six to eight years. Now, the government is trying to figure out how to buy services from private industry. SpaceX, which is delivering cargo to the International Space Station and hoping to soon transport humans, is a good example.

NASA is still spending taxpayer dollars to get "stuff" and people to space but doing so in a different way. Instead of buying the hardware from a contractor and putting it on a government launchpad, they're now paying a contractor with its own launch vehicle and the government launch pads are often controlled by contractors. This transition is similar to how GeoEye and DigitalGlobe transformed the business of remote sensing.

We haven't figured out how a similar model is going to work with regard to flying humans to space, but people are trying. It's still a stretch to see how we are going to get to a private space station that amounts to a "Marriott on orbit," but I hope it happens—as long as it's done in a way that doesn't make the space traffic management and orbital debris situations worse.

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