2019 ISSUE 1

THE OFFICIAL MAGAZINE

OF THE UNITED STATES GEOSPATIAL INTELLIGENCE FOUNDATION

# An DOBIN Frontier

Open-source software has reached a tipping point. Why embracing an open community approach will enable a new generation of GEOINT.

- > The Changing Nature of GIS
- Perspective: Ivan DeLoatch, Federal Geographic Data Committee



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# CONTENTS 2019 ISSUE 1

### **10** AN OPEN FRONTIER

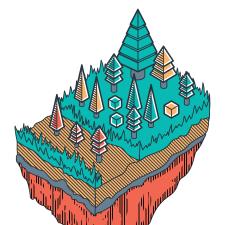
Open-source software has reached a tipping point. Why embracing an open community approach will enable a new generation of GEOINT. By Matt Alderton

OpenStreetMap's GPX (GPS exchange format) at world scale.

#### FEATURES

#### 18 THE CHANGING NATURE (AND MAYBE NAME) OF GIS

With geospatial information becoming more and more ubiquitous, what is the future of GIS as a term and as a profession? by Rob Pegoraro



**02 VANTAGE POINT** A fond farewell from Keith Masback

**04 INTSIDER** New opportunities for commercial GEOINT; NGA Director Cardillo on talent acquisition; Augmenting analyst missions; YPG in action; EdGEOcation events

22 | MEMBERSHIP PULSE Perspecta, Woolpert, Individual Member David Grosso

26 | HORIZONS Reading List, Peer Intel, USGIF Events Calendar

#### TRAJECTORYMAGAZINE.COM

#### VIDEOS

As you prepare for GEOINT 2019, visit **trajectorymagazine.com/videos** to get up to date on content you may have missed at GEOINT 2018!

28 | PERSPECTIVE Q&A with Ivan DeLoatch, Federal Geographic Data Committee



#### **MORE GREAT CONTENT**

Visit us online for event recaps, GEOINT Community news round-ups, blog posts, guest articles, and more!

# **A Fond Farewell**

It's 2019 and the transition to a new year is metaphorical for the change that has occurred at USGIF over the past six months. Like the promise of a new year, the shift at USGIF similarly creates opportunity for new faces, fresh perspectives, and innovative approaches. What will not change is the Foundation's clarity of mission and purpose, and the associated focused resolve that our members and partners expect and deserve.

As part of this evolution, after more than a decade at the helm of USGIF, I'm moving on. Despite the deeply rewarding and genuinely enjoyable nature of my position, my family

obligations made it

increasingly clear

make the difficult

decision to depart

The loss of my wife,

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Allison, in 2016

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that I needed to



Keith Masback and his five children.

challenged my ability to be the kind of father I want to be, and although we'd successfully launched our four sons off to college, our daughter remains at home as a junior in high school. I need to be present for her, and now I will be.

As I often say with regard to my somewhat circuitous career path, it's sometimes better to be lucky than good. (Of course, being both is nice as well.) I feel incredibly lucky to have been part of the USGIF team, providing leadership for and contributing to the maturation and expansion of the GEOINT Community, and in turn, our nation's security.

Upon my arrival in early 2008, I was asked by the USGIF Board of Directors to lead the organization on a path from "a Symposium with a Foundation attached to it, to a Foundation which accomplishes a number of things, to include a world-class Symposium." Together, we've achieved this and so much more. The Foundation's success is truly the GEOINT Community's success. The myriad people and organizations responsible for this are united by a single underlying theme: selflessness.

In 10 years, I've never promised an executive at a member company that their engagement with USGIF would result in a contract award. I've never promised a volunteer that their career would be advanced by participating in a USGIF committee or working group. I've never provided government or military speakers at our events with anything more than a sincere thank you and a challenge coin. And the small USGIF staff works tirelessly, maximizing our organizational efficiency and effectiveness while remaining relentlessly dedicated to our members and the mission. Our Community has bought in to the broad philanthropic vision of the Foundation since the organization's inception in 2004.

The return on investment of time and treasure by our members, volunteers, speakers, and writers continues to be the ascendance of GEOINT as an intelligence discipline, and its growth outside of the traditional defense, intelligence, and homeland security arenas into a broad swath of verticals in the global economy. As I've said often in the past 12 to 18 months there has never been a more exciting time to be a GEOINTer.

I'm sincerely grateful to have been a part of this journey, and to contribute to the progress we've made to date. Thank you to the USGIF staff as well as to my many mentors, colleagues, partners, and supporters. This decidedly isn't goodbye. I remain a dedicated member of this Community, a Lifetime Member of USGIF, and a member of the Foundation's Board of Directors.

Penning my last Vantage Point column for *trajectory*, a publication we conceived, launched, and nurtured during my time at USGIF, and into which I've invested a tremendous amount of time and energy, is indeed bittersweet.

I'm deeply appreciative to all of you for the privilege to play an integral role in the first 15 years of the Foundation's existence, and I'm excited about what lies ahead. Thank you.

**KEITH J. MASBACK** @geointer

# trajectory

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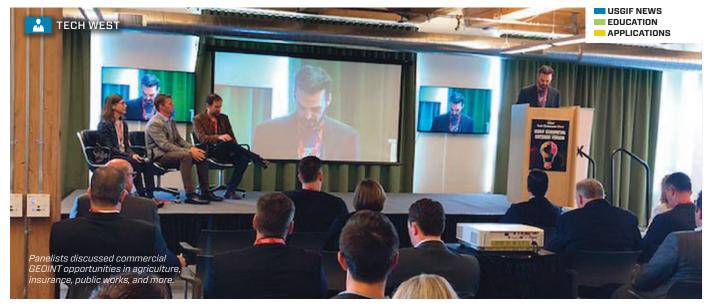
# **Accredited Programs**



There's no better time than the present. Earning a geospatial intelligence certificate from a USGIF-accredited institution provides the skills required to address challenges, offers competitive advantage, and ensures organizations hire high-caliber employees who understand GEOINT.

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# NTSICE COMMUNITY NEWS, EVENTS, AND EDUCATION



## New Opportunities for Commercial GEOINT

"In 2022, insurance will probably be our largest [market]."

- ROBBIE SCHINGLER, CO-FOUNDER AND CHIEF STRATEGY OFFICER, PLANET GEOINT has recently matured beyond its national security upbringing and surged into the commercial marketplace. As part of its October Tech Showcase West events in St. Louis, Mo., USGIF hosted a Commercial GEOINT panel discussion at the T-REX technology incubator.

Agriculture is an enthusiastic adopter of GEOINT. Dr. Martin Mendez-Costabel, geospatial big data engineering and strategy lead for Bayer Crop Sciences, explained how GEOINT is yielding new capabilities for the company. Mendez-Costabel's Location 360 team runs aerial and satellite imagery through its data processing platform to help farmers in 60 countries maintain soil health, improve farming procedures, and minimize crop damage.

Small satellite data provider Planet has a strong presence in agriculture as well. Co-founder and chief strategy officer Robbie Schingler called it the company's "largest market," accounting for "40 to 50 percent" of its revenue.

Dutch street-level imagery provider CycloMedia Technologies has found its niche serving public works organizations. Senior Manager of Solution Engineering Jennifer Kuntz demonstrated CycloMedia's panoramic views of major world cities, created with a patented data processing method that merges traditional imagery with LiDAR. Utility companies use these panoramas to read asset tags, monitor equipment along roadways, and identify places where overgrown vegetation might interfere with power lines.

All three companies are focused on diversification. Planet anticipates significant growth in the insurance industry.

"In 2022, insurance will probably be our largest [market]," Schingler said. "It can save a lot of costs and open up new product opportunities in parametric modeling and payouts before disasters happen to mitigate loss of assets."

Since 2009, Planet has collected petabytes of imagery every day, compiling it in a repository representing several years of physical global change. Now, the company wants to index that change and make it searchable by category. Planet's tool would use open-source machine learning algorithms for object detection and land classification. Eventually, such a tool could feed into business intelligence throughout the commercial market.

"That's the huge market opportunity for our industry today," Schingler said. "Part of the national security mission is economic prosperity for the nation, and we have an opportunity to create a whole new market, to bring geospatial data information services to the business-to-business information feed economy."

Mendez-Costabel noted Bayer also plans to incorporate machine learning and AI to develop "edge analytics," bringing data processing and analysis capabilities to remote locations—corn fields in rural Iowa, for example.

AI is exciting and often improves efficiency, but mindlessly integrating it into a company's workflow is not a direct line to commercial success. According to Mendez-Costabel, the hard science and phenomenology element remains critical for companies to understand, explain, and correctly target their use of emerging technology.

#### The National Geospatial-Intelligence Agency's internship program has **GFOWN MOFE** than 3x since its establishment under Director Letitia Long.

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#### NGA Director Robert Cardillo on Talent Acquisition



For decades. NGA served as the nation's hub of geospatial technology. Now that GEOINT has emerged widely in the commercial marketplace, the role of the agency is evolving. To open USGIF's Tech Showcase West events Oct. 16 in St. Louis. Mo., former NGA Director Letitia Long interviewed current Director Robert Cardillo in a "fireside

Former NGA Director Letitia Long interviewed current Director Robert Cardillo during USGIF's Tech Showcase West.

chat" discussing these issues and more. Cardillo noted NGA's legacy of service in St. Louis and the agency's ongoing development of its Next NGA West facility.

As NGA grows, one of its biggest challenges is talent acquisition. In St. Louis, recruiting efforts have already manifested as partnerships with geospatial programs at local universities and K-12 schools, which the agency hopes will serve as pipelines for rising geospatial practitioners. These efforts have grown NGA's internship program more than threefold since its establishment under Long's leadership.

Sustainable employment is an important focus for the agency, which must contend with tech giants to hire and hold on to in-demand developers and data scientists. Cardillo acknowledged that many people in today's workforce want mobility, and he said NGA is working to better accommodate employees seeking career changes.

"If we're going to get the talent, we have to think differently about how we access that talent," Cardillo said. "We fully expect for people to do federal stints, commercial, teach, go to a different industry for a while, but we want them to come back."

One reason for this high turnover is that innovation is traditionally easier to achieve in the commercial world. Federal agencies sometimes shy away from early-stage innovation in favor of time-tested, approved procedures. Cardillo said the appeal of NGA's mission is finding ways to use industry innovations, such as AI and machine learning, to secure advantages over international adversaries.

Cardillo hinted at one such innovative tool NGA is testing: an AI application to monitor pattern-of-life data for Russian long-range aviation capabilities, which has been a challenge for U.S. intelligence since the Cold War.

Of course, an AI capable of counting Russian bombers is bound to raise eyebrows among human analysts who've performed this job. But Cardillo maintained humans will always remain an integral part of the team and should not feel threatened by the introduction of AI. NGA is focusing on "displacing" analysts from their current daily tasks and assigning them new, higher-capacity ones rather than "replacing" them.

"I want you to move, but I want you to move up," Cardillo said. "I want the machine, the algorithm, the automation to lift you so you can see farther and understand deeper."

#### PROCRASTINATION TOOLS



#### **Google Lens**

The Google Lens platform brings computer vision and object identification to smart phone cameras. When pointed at an object, Lens launches an internet search on the image, pulling together information such as descriptions, reviews, and purchase links. It can be used to improve retail shopping experiences, find restaurants, identify plants and animals,

copy text, learn about nearby landmarks, and more. Lens is available for download via the Google Play Store and is built into Google's Photos and Assistant apps. **lens.google.com** 

#### Curbside

The Curbside app uses location technology to reinvent how people shop. With it, users can select and pay for items from nearby stores or restaurants ahead of time and arrange for their orders to be hand-delivered to their vehicle as soon as they arrive. This helps busy shoppers save time by avoiding searching for parking and waiting in long checkout lines. **curbside.com** 





#### iExit

Designed for long-distance highway drivers, iExit shows the gas, food, and lodging options located near every interstate exit in the U.S. Users can compare pricing between vendors and download travel coupons for certain brands to save money on long road trips. The app doubles as a marketing tool, offering "sponsorship" to one business per exit in the form

of a banner advertisement visible to users as they near the location. **iexitapp.com** 

## INTsider

🔒 USGIF STAFF

#### USGIF Appoints New Members to Senior Leadership Team



USGIF recently welcomed two new members to the Foundation's senior leadership team. **Karin Soyster Fitzgerald,** a seasoned trade association and meetings professional, joined USGIF in November as chief operating officer.

Fitzgerald, a Certified Association Executive and Certified Meeting Professional, brings with her nearly 30 years of membership, meetings, and operations experience. Most recently, she served as chief operations officer and deputy executive director of the International Association of Fire Chiefs. At USGIF, Fitzgerald will contribute to the development of the Foundation's strategic goals, implement new processes to achieve success, and identify opportunities for USGIF to leverage cross-program strengths.

#### Ronda Schrenk,

a 25-year GEOINT professional, joined USGIF in December as vice president of programs. Schrenk has held various positions at NGA since 1997, most recently on assignment to the Intelligence and



National Security Alliance (INSA) as the senior fellow for public-private partnerships. At INSA, Schrenk managed working group efforts and led content development for a variety of forums bringing together experts from both inside and outside of government to discuss pressing national security issues. Schrenk will lead USGIF content development for all events and programs, including the annual GEOINT Symposium and a variety of workshops. She will also be responsible for supporting USGIF volunteers as they lead important working group efforts.



The USGIF-accredited NOVA Information Management School signed an MoU with the Portuguese Military Academy.

#### GEOINT CERTIFICATES

#### NOVA IMS Partners with Portuguese Military Academy to Offer Joint USGIF GEOINT Certificate

USGIF-accredited NOVA Information Management School in Lisbon, Portugal, and the Portuguese Military Academy signed a Memorandum of Understanding (MoU) through which both institutions will offer a joint USGIF GEOINT Certificate. The certificate program will begin in February 2019.

The MoU was signed by Professor Pedro Saraiva, Dean of NOVA IMS, and Major-General João Vieira Borges, commander of the Military Academy. Professor Marco Painho of NOVA IMS and Colonel José Fernandes of the Portuguese Military Academy will coordinate the certificate program. NOVA IMS is one of 16 accredited schools participating in USGIF's Collegiate Accreditation Program.

#### PROFESSIONAL CERTIFICATION Soldiers and Marines Eligible for GEOINT Certification Reimbursement

U.S. soldiers and Marines can now apply for USGIF's Certified GEOINT Professional (CGP) program and have the Army or Marine Corps reimburse their exam fees.

To learn more, visit the Army Credentialing

Opportunities On-Line (COOL) website or the Marine Corps COOL website and search for your Military Occupational Specialty (MOS) to determine whether you are eligible.

"As an Army veteran, I understand the uniquely rigorous GEOINT training our military members receive and the experiential multiplier created by the applied nature of their respective service missions," said USGIF Board member and former CEO Keith J. Masback. "USGIF is proud to provide a reimbursable pathway for members of the U.S. Army and Marine Corps to demonstrate their GEOINT competencies to potential employers via a nationally-accredited certification program."

# INTsider

#### MACHINE LEARNING & AI

# **Augmenting Analyst Missions**

Experts discuss training data, GEOINT assurance, and more at USGIF's Machine Learning & Artificial Intelligence Workshop



NGA's David Gauthier

2018 GEOINT Community Week, has grown each year, demonstrating steadily increasing demand for discussion and answers surrounding AI technology.

The two-day workshop was held at the National Geospatial-Intelligence Agency (NGA) in Springfield, Va., and included both an unclassified and classified agenda.

#### PREPARING AND SIMULATING TRAINING DATA

The unclassified programming featured two morning panel discussions on data—one on preparing training data for AI and machine learning systems, and another on simulating data to train artificial neural networks.

Dr. Shay Strong, director of data science and machine learning at EagleView, discussed the tradeoffs between data quantity and data quality—the former being necessary to scale and the latter being necessary to do so accurately.

Kate Werling, a senior solutions architect with Amazon Web Services, echoed Strong's sentiments, saying quality data equals a quality model—in other words, "garbage in, garbage out." She emphasized the importance of patience when building a quality dataset.

Werling also pointed to the need for specificity when instructing team members how to annotate data—for example, whether they are labeling cars or vehicles, or how tight the bounding boxes should be around the cars

Panelists who discussed the notion of simulating training data acknowledged the concept is nascent. According to the experts, the market for synthetic data sets is still immature, and though it is attracting some venture capital interest, no major companies have emerged yet in this niche.

Peter Bronez, a senior member of the technical staff at In-Q-Tel, said the motivation for developing simulated training data is that not everyone can gain access to big data, for financial reasons or otherwise. He added demand for simulated training data is likely to rise in correlation

USGIF's Machine "We're Learning and Artificial putting Intelligence Workshop analysts in in November attracted the driver's more than 300 GEOINT professionals-one of seat and the Foundation's largest thev're workshops to date. telling us Interest in the workshop, which was what they

workshop, which was hosted by USGIF's Machine Learning and Artificial Intelligence Working Group as part of the Foundation's Working Croup as part

> —DR. STEVEN HALL, MISSION LEADER FOR AAA, NGA

Experts discussed how to prepare the GEOINT workforce for machine learning and AI.



IMAGE COURTESY OF NGA

with the advent of autonomous vehicles—an industry facing challenges collecting adequate training data due to physical restrictions.

#### NGA & AAA

The afternoon unclassified agenda featured two NGA keynotes followed by a special edition of USGIF's GEOINTeraction Tuesday networking event in which remarks came from David Gauthier, director of NGA's new Commercial and Business Operations Group.

Dr. Steven Hall, NGA's mission leader for AI, Automation, and Augmentation (AAA), gave the first keynote. Hall clarified that automation does not always equal AI or machine learning and highlighted the importance of applying these new solutions to augment human analysts.

Hall said his team is pursuing goals brought to them by analysts who want to improve their workflows.

"We're putting analysts in the driver's seat and they're telling us what they need in order to do their jobs better," Hall said. "In the last two to three months we've seen more adoption and feedback than in the last two years."

Benjamin Tuttle, NGA's director of Outposts, said the agency's outpost in Silicon Valley is also working with analysts to define mission needs early in the research and development process; a machine learning ground order of battle prototype the group recently developed will be tested for the next six months on analyst desktops.

Tuttle added GEOINT assurance has recently become an important issue for NGA: "How do we track provenance as all of this information becomes available?"

Gauthier also pointed to the need to secure the AI supply chain and study data provenance during his GEOINTeraction Tuesday remarks, saying industry can help the agency "assess commercial services flooding the market."

"AI is changing our lives right now," Gauthier said. "The AI thing is something we have to solve, not just for GEOINT but for all of society."



IMAGE COURTESY OF NGA



# Young Professionals in Action

As a kickoff to USGIF's Tech Showcase West events in October, the Foundation's Young Professionals Group (YPG), in partnership with GeoSTL, hosted a networking event at the T-REX technology incubator in downtown St. Louis, Mo. Attendees heard from T-REX Executive

USGIF is now accepting applications for its GEOINT 2019 YPG Golden Ticket Program. USGIF will select 30 young professionals to attend the GEOINT 2019 Symposium, June 2-5, in San Antonio, Texas. Visit **usgif.org/community/ypg** to learn more. Applications are due March 20. Director Patricia Hagen and USGIF Board Member Patty Mims about USGIF's initiative to promote GEOINT in the St. Louis region.

Also in October, YPG teamed up with IBM to offer an Intro to Coding workshop through which nearly 20 young professionals gained hands-on experience with coding in NODE-RED using a Raspberry Pi.

Following George Mason University's GIS Day event in November, YPG hosted a networking reception at Oh George in Fairfax, Va., for students to network with young professionals working in the GEOINT field. The event was sponsored by Radiant Solutions.

Supporting the giving season in December, YPG members volunteered at the EOD Warrior Holiday Dash in Washington, D.C., helping at water stations and at the finish line. The EOD Warrior Foundation provides financial assistance and support to wounded EOD warriors and their families. Also, as part of the YPG Holiday Celebration, the group collected items to be donated to Toys for Tots.



SCHOLARSHIPS

#### Apply for a 2019 USGIF Scholarship!

The annual USGIF Scholarship program recognizes the achievements of graduating high school seniors, undergraduate, graduate, and doctoral students. The Foundation has awarded more than \$1.2 million in scholarships since launching the program in 2004.

Scholarship recipients are selected based on their academic and professional excellence in the geospatial sciences and related fields. All students interested in applying geospatial data and technology to address global security challenges are encouraged to submit applications. Past scholarship recipients are also invited to apply. Applications are due May 25.

Visit usgif.org/ education/scholarships to learn more and to apply!

#### ACADEMIC FORUMS

#### On the Road (and the Web) with USGIF's Dr. Camelia Kantor

USGIF's Vice President of Academic Affairs Dr. Camelia Kantor recently participated in several educational forums. In November, Kantor participated in a webinar titled "Geospatial Intelligence and Education," hosted by the American Society for Photogrammetry and Remote Sensing (ASPRS) Eastern Great Lakes Region, where she copresented with Associate Professor Rakesh Malhotra from USGIF-accredited North Carolina Central University.

Also in November, Kantor gave a presentation titled, "Maturing a Profession: How Education and Certification Play a Role" for the Institute for Credentialing Excellence's Conference in Austin, Texas. Kantor and Christopher Anderson, senior director with Global Skills Exchange Corporation, discussed USGIF's Essential Body of Knowledge, Certified GEOINT Professional program, and academic programs.

Additionally, Kantor gave a lightning talk on "The Downside of Modern Energy Access" at the American Geographical Society's Geography 2050 event at Columbia University in November.

In December, Kantor participated in a University Consortium for Geographic Information Science (UCGIS)-led webinar: "Using Professional Credentialing Exams within Academic GIS Contexts."



Dr. Camelia Kantor

# INTsider

# **Fall EdGEOcation Events**

The past few months have been an exciting time for USGIF's K-12 program:

#### STEMULATE

As part of USGIF's Tech Showcase West events in October, the Foundation held its first STEM event called "STEMulate: St. Louis" at Saint Louis University. The event attracted nearly 150 children and their families and featured USGIF's Portable Planet map, interactive activity stations led by 10 exhibiting organizations, and a panel discussion on geospatial careers.

#### **INTRO TO GEOINT**

In October, USGIF gave its Intro to GEOINT presentation to geometry students at Seneca Ridge Middle School in Sterling, Va., and geoscience students at James Madison High School in Vienna, Va. USGIF staff visited Creighton's Corner Elementary in December to share the presentation with students in the school's gifted and talented program. Also in December, local Girl Scouts visited USGIF's headquarters in Herndon, Va., to learn about GEOINT.

#### **PORTABLE PLANET**

In December, USGIF shared its Portable Planet map of North America for the Sliding Doors: STEM and Dyslexia Center's Science Saturday event at OGSystems in Chantilly, Va. Portable Planet also traveled to Wallenpaupack Middle School in Hawley, Penn., and to STEM Night at Moorefield Station Elementary School in Ashburn, Va., in December.

#### GEOPLUNGE

USGIF staff and YPG volunteers judged a GeoPlunge DC tournament in December. More than 230 students representing 26 schools from the Washington, D.C., area attended to play the geography card game.

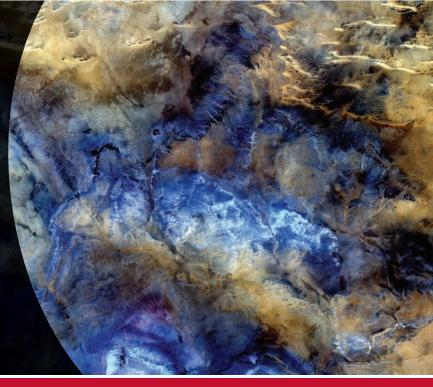


At USGIF's first STEMulate St. Louis event, children learned about geography and geospatial technologies from local companies and organizations.

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Open-source software has reached a tipping point. Why embracing an open community approach will enable a new generation of GEOINT.

**IF ECONOMIC ILLNESSES** had physical instead of fiscal symptoms, the construction industry would have a harsh cough and aching muscles. For now, it's working through the pain. If left untreated,

80

however, its condition could become chronic. Perhaps even terminal. >>



As a result of myriad factors—including declining immigration, reduced funding for high school shop classes, and the lingering effects of the 2008 housing crisis—the construction industry is in the midst of a dire labor shortage. In August 2018, construction employers in the United States had 317,000 unfilled positions—the largest number of open construction jobs since the Great Recession. In September, the U.S. Chamber of Commerce's quarterly Commercial Construction Index likewise showed that 94 percent of contractors are having a difficult or moderately difficult time finding skilled workers.

The consequences of inadequate labor are as acute as they are numerous. For one, buildings take more time and money to complete. Companies and communities, meanwhile, are unable to grow. Because they must do more with less, builders are tempted to take shortcuts, creating unnecessary risks that compromise quality and safety. But from necessity comes innovation: The construction industry is rapidly shifting to a new business model based on modular rather than conventional construction.

While conventional buildings are built entirely onsite, modular buildings consist of standardized components that are pre-fabricated in an offsite factory, then assembled in the field. Like structures made from toy LEGO bricks, modular buildings can be configured in any fashion, then customized with accessories and embellishments; the underlying components, however, are identical. With conventional buildings, contractors are limited by environmental conditions

### IS OPEN-SOURCE SOFTWARE SECURE?

On Sept. 7, 2017, IT professionals everywhere received a bucket of cold water to the face when news broke of the biggest data breach in U.S. history—criminals hacking into the databases of credit reporting agency Equifax had stolen the personal information of 148 million Americans.

For those affected, perhaps the worst thing about the breach was that it could have easily been prevented: The hackers' mode of attack was a vulnerability in Apache Struts, an open-source web application development framework. Though a patch was released six months before the attack, Equifax had failed to install it. The incident gave new life to an old debate about whether open-source software is secure.

"Imagine you're driving a car. If you have a Prius, you trust that Toyota has checked its supply chain; they know where all their parts come from and they have a rigorous process to make sure that when they assemble it, the final car is safe. Exactly the opposite is true in software," said Mark Curphey, vice president of strategy at CA Veracode, an application security firm that specializes in securing open-source software. "In software, you've got no clue where the steering wheel, the brakes, or the seatbelts came from."

This doesn't mean all opensource software is risky. In fact, its nature means opensource software has a superior security posture in some ways.



"With open-source software, people can see the code. That's actually a good thing because it creates a vested interest for the software provider to practice good security hygiene," said David Egts, chief technologist for the public sector organization at Red Hat. "If people can look at your code and see that it's [full] of security vulnerabilities and bugs, you're not going to last very long."

Instead of embracing or rejecting open-source software wholesale, users should establish a risk-management process for evaluating it.

"There's four questions you need to ask every time you're considering open-source software," Curphey concluded: "What am I using? Where did it come from? What does it do? And what is its quality? Going back to the car analogy, it's all about building a digital supply chain." and linear construction in which each successive step must be completed before the next can begin. With modular buildings, construction takes place in a controlled environment, wherein processes that would normally unfold in succession do so in parallel. As a result, modular buildings can be completed faster, cheaper, safer, and with fewer workers.

Like the construction industry, the GEOINT Community has insufficient resources relative to demand for its services, which is growing rapidly thanks to an influx of geospatial data from small satellites, unmanned aerial vehicles (drones), and the Internet of Things.

"There's more location information coming into organizations than ever before," said Andy Dearing, CEO of geospatial software and services company Boundless. "What we see in the geospatial space is that organizations are trying to figure out how to scale their location enterprises to process all that data and make more informed decisions. Traditional proprietary technologies aren't built to do that."

Like builders, many geospatial practitioners are adding to their toolbox with a modular solution: open-source software, which is already changing the course of geospatial intelligence.

#### **OPEN EVOLUTION**

Though it's new to many organizations, open-source software isn't new at all. In fact, it's as old as computing itself. As early as the 1950s, computer hardware was distributed not only with free operating software, but also with its source code so bugs could be fixed and new functions could be added. This was thanks to early adopters, most of whom, as academics and researchers, were collaborative and open by nature. Only when computing became commercialized in the 1970s and '80s did software become commoditized and "closed."

As for the modern notion of opensource software, most developers trace its roots back to 1991. That's when Finnish computer science student Linus Torvalds created Linux, a free and open-source operating system inspired by Richard Stallman, a computer programmer at the Massachusetts Institute of Technology (MIT), who, in 1983, established the GNU Project to create free and open software. "Richard Stallman ... was an early thinker and proponent of 'free' software," said Richard Grady, president of Applied Geographics (AppGeo), a GIS consulting firm that has used open-source software since 2008. "He believed software should be free to run, free to study, free to modify, and free to share."

In the GEOINT Community, open-source software has an unlikely grandfather: the federal government. In 1979, the U.S. Department of the Interior created the Map Overlay and Statistical System (MOSS) to help the U.S. Fish and Wildlife Service track and evaluate the impact of coal mine development on the environment. To maximize development speed and minimize development cost, the committee in charge mandated MOSS use as much code as possible from the public domain. The resulting product was the world's first broadly deployed, vector-based, interactive geographic information system (GIS).

In 1985, the U.S. Army's Construction Engineering Research Laboratory released the Geographic Resources Analysis Support System (GRASS), an open-source GIS software suite created to assist the military with land management and environmental planning.

"There were proprietary vendors that had GIS packages, but when the government approached them with [additional requirements] they said, 'Sorry, that's not really our thing.' So the government decided to write its own software and put it out under an open license," said open-source advocate Dr. Christopher Tucker, principal of Yale House Ventures.

GRASS-whose code continues to underlie open GIS software more than 30 years later-laid the foundation on which all subsequent open-source geospatial solutions were built. A few of the most significant were: the Geospatial Data Abstraction Library (GDAL), created in 2000 for the purpose of reading and writing raster and vector geospatial data formats; Geo-Server, launched in 2001 to facilitate sharing of geospatial data; PostGIS, released in 2001 to add support for geographic objects to the PostgreSQL (Postgres) open-source relational database; QGIS, an cross-platform desktop GIS application introduced in 2002; and Cesium, a JavaScript library developed in 2011 for use with 3D mapping applications.



"Open-source software used to be hard: A government had to decide to invest in a piece of software. A government had to decide to spin it out. And a government had to apply dollars and lawyers and developers," Tucker said. "But by the mid-2000s you started seeing more and more developer infrastructure out there that made it easier for developers around the world to coordinate."

It was a short leap from coordination to organization. In 2006, open-source developers established the Open Source Geospatial Foundation (OSGeo), whose annual Free and Open Source Software for Geospatial (FOSS4G) conference attracts more than 1,000 open-source developers and advocates every year.

Another powerful inflection point was the 2008 formation of GitHub, the web-based repository through which open-source software developers store and share their projects for consumption by the global developer community.

"GitHub made it super easy for communities of developers all around the world to collaborate," continued Tucker, who calls GitHub a revolution in code management and IT software project management. "Every cool, smart kid realized that if they didn't like their job and had a good idea, they could develop software on the side and create something amazing. That poured fuel on the fire."

The brighter the fire burned, the more attention open-source software received. Now, the flames are so hot that even the most "closed" users like the Intelligence Community are creating and executing open-source strategies.

"The federal government is interested in having open and transparent conversations. Not just with words, but with code," Dearing said. "They've realized, 'We can't do it all ourselves anymore. We need help, and there's help out there."

#### **SUPER SOFTWARE**

There are many reasons the GEOINT Community has embraced open-source software in both the public and private sectors.

For government users, the most attractive benefit is cost, according to Will Mortenson, lead for volunteered geographic information at the National Geospatial-Intelligence Agency (NGA), which in 2014 became the first U.S. intelligence agency to share open-source software on GitHub. "We've historically had more requirements than we could answer with our traditional budget," explained Mortenson, who said open-source software is an affordable alternative to single-use solutions; while the latter must be built from scratch—usually at considerable expense—the former often meet most of NGA's requirements out of the box, and can be customized to fill any gaps.

Achieving scale can also be cost-prohibitive.

"With open source, the incremental cost of scaling up is near zero," Grady said. "Because you're not paying for software licenses, you can add users. And when GRASS—the code of which continues to underlie open GIS software more than 30 years later—laid the foundation on which all subsequent opensource geospatial solutions were built.

### OPEN SOURCE IN THE INTELLIGENCE COMMUNITY

Being "closed" by design, the U.S. Intelligence Community (IC) is the last place many people would expect open-source software to proliferate. Because it recognizes the inherent advantages, the IC has proven to be both an enthusiastic user of open-source solutions and a valuable contributor to the open-source community.

"The intelligence agencies are all-in on open source," said Richard Grady, president of Applied Geographics, a GIS consulting firm that builds and deploys open-source geospatial software. "They understand that being smarter, faster, and more agile is how you maintain your global advantage."

Examples abound of open-source geospatial software in the IC.



#### MOBILE AWARENESS GEOINT ENVIRONMENT (MAGE)

The National Geospatial-Intelligence Agency (NGA) created MAGE in 2014 to provide situational awareness to security personnel supporting events such as the 2014 Winter Olympics in Sochi, Russia.

"MAGE is a very simple application to track location information of a mobile device and make what we call observations," explained Ben Foster, NGA's product manager for mobile development and operations.

The National Guard field-tested MAGE when Pope Francis visited New York in 2015.

"Everyone on the ground could see

each other's location using their mobile devices and quickly drop a point, take a picture, and make an observation," Foster said. "For example, if there was a suspicious package left on a corner, in near real time everyone on that team would be notified."

Because MAGE is open-source, NGA's partners can deploy it quickly, easily, and affordably For example, the Federal Emergency Management Agency (FEMA) used MAGE in 2017 to gain situational awareness in Puerto Rico after Hurricane Maria.

"We're contributing to solving geospatial problems, but we're enabling it to be organic to the organization that is out there operating within those problems," Foster said.

#### NSG OPEN MAPPING ENCLAVE (NOME)

Another NGA application of note is NOME, an opensource mapping environment that allows NGA partners to generate dynamic geospatial content in support of U.S. missions around the world. Essentially, it's the IC equivalent



of OpenStreetMap, Wikimaps, and to a certain extent Google, enabling warfighters, humanitarians, and others to crowdsource collaborative living maps that provide situational awareness.

"We don't have enough resources to answer every requirement," said Will Mortenson, NGA's lead for volunteered geographic information. "[NOME] is an effort to find alternative mechanisms that give folks the opportunity to create more content."

Approximately 1,500 users from 27 nations currently use NOME during military and humanitarian assistance operations. NOME works, Mortenson said, because it leverages the wisdom of the crowd. And the reason it can leverage the wisdom of the crowd is because it's accessible to users across disparate geographies, communities, and security domains.



DIA's Terry Busch

#### MACHINE-ASSISTED ANALYSIS RAPID-REPOSITORY SYSTEM (MARS)

The Defense Intelligence Agency (DIA) is a voracious consumer of data. But its central data repository, the Modernized Intelligence Database (MIDB), hasn't been reengineered since 1996. Enter MARS, which will leverage advances in cloud computing and machine learning to make foundational intelligence gathering a dynamic endeavor.

"MARS is a program to take foundational intelligence and reinvent it to support a Department of Defense that requires an increasing level of automation and an increasing level of fidelity with data as we move into the future," explained MARS Program Lead Terry Busch.

MARS will support "millions of transactions per second" through machine-to-machine operations, according to Busch, who said the new system will "move decision-making into the cockpit" for warfighters who have a growing appetite for large amounts of granular data. The program is still nascent, but open-source solutions are playing a significant role in

its development. "Open source initially provides us neutral ground to reset our technology, and we have done

that," explained Busch. "One advantage of open source is that you have a crowd of people developing solutions, so there's a good, rich set of open-source capabilities that the world is rapidly improving. If I have a system that's designed to continuously adapt and develop to support the warfighter, that might be a good model fit for us."

With open source, DIA can onboard new capabilities immediately instead of waiting months or years for the traditional procurement cycle.

"Open source is definitely changing the way we think of technology development," Busch concluded. "Rather than procuring on long cycles and seeing improvement on a sort of release schedule, we can bring code in and constantly evaluate, adapt, and build." "There is a tremendous amount of knowledge development in software. Leveraging that knowledge is how we build on those who went before."

-RICHARD GRADY, PRESIDENT, APPLIED GEOGRAPHICS

there is no friction to adding users, there is much greater adoption and utilization of technology, and much greater sharing of data."

Echoed former Boundless CEO Eddie Pickle, managing director of open-source programs at GEOINT services company Radiant Solutions, "In the '90s, proprietary software was [synonymous with] interoperability. The way we moved data around and tried to solve problems together was having a lot of people rallied around using similar technology. But the development of the internet blew that ecosystem wide open. ... You just couldn't deploy a solution where you knew you were going to have to make everybody down the chain invest in proprietary software. There was nothing wrong with the software, but you just couldn't predict how much of it you really needed. That led to the demand for open-source software."

And licensing isn't just expensive, it takes time. "When most people encounter free and open-source software, the tendency is to focus on the 'free' aspect: Why would you pay for software when you can get it for free?" said Peter Girard, chief technology officer at AppGeo. "Personally, I don't find the free aspect of open-source software all that compelling. If something has value, I'm willing to pay for it. Why I favor open-source over proprietary software is because it gives me freedom. I don't have to ask permission to use a piece of software. If I determine, for instance, that I need to use Postgres and PostGIS as my geospatial database, I just do it."

Open-source software also accelerates innovation by streamlining development. "There's no value in building table stakes—things that every app has to do, like user management, payment gateways, and logging," said Mark Curphey, vice president of strategy at CA Veracode, an application security firm that specializes in securing open-source software. "So over the years people have extrapolated that stuff into reusable code libraries and frameworks that everyone can use, which allows developers to focus on building differential features."

If software development were a queue, open source lets developers skip to the front of the line.

iiid on"The barrier to entry ... is very low, so you can get lots<br/>of grassroots adoption by integrators and engineers to try<br/>things out and prototype, which lets you move very quickly,"<br/>explained Cesium creator Patrick Cozzi, principal graphics<br/>architect at Analytical Graphics Inc., who said another advan-<br/>tage of open source is customization. "In the GEOINT space, in<br/>particular, the need for customization is often very high."

Arguably the greatest benefit of open-source software, however, is the community of users behind it.

"When I'm contributing to open-source software, the maintenance and development of that software does not fall squarely on my shoulders," said Scott Clark, a program manager at Radiant Solutions, where he specializes in open-source software development. "[PostGIS creator] Paul Ramsey did a great talk a few years ago and compared open-source software to a barn raising. When you wanted to raise a barn back in the day, the community would come out and help you build it because you couldn't do it by yourself. That helped out the community, because the next time somebody else had to raise a barn they got help, too."

Open-source software often has thousands of stakeholders, according to Grady, who said quantity of users typically correlates with quality of software.

"There is a tremendous amount of knowledge development in software," Grady said. "Leveraging that knowledge is how we build on those who went before."

The open-source community believes in the group so strongly that it even has a term for its potential: Linus's Law, named for Linux creator Linus Torvalds.

"Linus's Law states, 'With sufficient eyes, all bugs look shallow," said David Egts, chief technologist for the public sector organization at open-source solution provider Red Hat. "What that means is: If you have a robust community of people working on your code, the level of innovation is going to be higher."

From a GEOINT per-

spective, having a large and diverse community with which to share code also makes it possible to evangelize and evolve the profession. NGA, for example, is using open-source solutions to increase GEOINT adoption globally.

"Geospatial technology applies to a whole set of various problems that don't just span across the IC and DoD," said Ben Foster, NGA's product manager for mobile development and operations. "By open sourcing the stuff that we're producing, we're lowering the barriers of entry [into GEOINT services] for a lot of our international partners."

Added Cozzi, "Once you make something open-source, anyone can pick it up. Cesium, for example, is used by

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"More often than not, a hybrid environment works best because you can pick and choose where it makes sense to implement open-source technologies and where it doesn't."

-ANDY DEARING, CEO, BOUNDLESS

NGA's Map of the World web client in the GEOINT world, but it's also used by Mozilla for mixed reality, by the Toyota Research Institute for autonomous driving simulation, and by Bentley Systems for CAD/BIM fusion with geospatial data. The list goes on and on, and each of those different types of users brings use cases and perspectives into that core platform to improve it."

#### **A HYBRID APPROACH**

Despite the boom in open-source software adoption, proprietary software-also known as commercial off-the-shelf (COTS) software-still has many advantages. For one, the "free" in "free and opensource software" often refers to freedom, not cost. So while many open-source solutions are gratis, not all of them are. Plus, open-source software typically does not come with technical support, so organizations may have to hire experts to assist with implementation, integration, and ongoing administration. Costs can therefore be unpredictable relative to proprietary solutions.

Vendor viability is another concern. Compared to open-source providers, which are often vulnerable to acquisitions, mergers, and failures, proprietary vendors tend to have more stability and longevity, and can therefore promise greater continuity.

With open-source, the developer community controls the product roadmap. Often, this results in features and capabilities that users want. Sometimes, however, solutions veer in undesirable directions. Therefore, proprietary vendors may give individual users more control in pursuit of their unique requirements.

Given their respective strengths, the best solution for GEOINT needs lies in neither open-source nor proprietary software exclusively. Rather, it's applying the best of both using open platforms and standards.

"We don't recommend ripping out and replacing proprietary solutions. We advise people to put open-source technologies alongside proprietary technologies because there are ways to implement and integrate," said Dearing of Boundless, whose core business is providing commercial support for opensource geospatial software. "More often than not, a hybrid environment works best because you can pick and choose where it makes sense to implement opensource technologies and where it doesn't."

The upside of a hybrid approach is evident in one of open-source software's unlikely proponents: Esri. Though its GIS software is the definition of COTS, the company nonetheless has welcomed open-source philosophy in order to enhance its proprietary offerings, leveraging the best of both.

The OpenStreetMap Foundation released a large dataset (spanning nearly eight years) of usercontributed GPS tracks. The dataset consists of nearly three billion points.

One way Esri participates in the open-source community is with open specifications, which it co-develops as a participant in the Open Geospatial Consortium (OGC). "Esri has made a strong commitment to being an open platform, meaning we are very focused on standards and making sure those standards support an open ecosystem," explained Ben Conklin, defense and intelligence industry



manager at Esri.

Open standards enable interoperability between closed- and open-source systems.

"We see this a lot in the GEOINT Community todayboth open-source and commercial software, working hand-in-hand through the interoperability of open formats and open standards," Cozzi said.

Esri also supports opensource projects as a user whose feedback contributes

to fixes and updates that benefit the entire user community. Its software, for example, supports the Red Hat Enterprise Linux and SUSE Linux open-source operating systems, as well as the Postgres open-source database. It also incorporates numerous opensource tools, languages, and libraries. And the company regularly shares via GitHub its own open-source applications that help users customize and extend its proprietary GIS software.

Though there's no denying the potential merits of open code, the sum of Esri's efforts is something Conklin believes is more powerful: open community. "To me, the most important aspect of open source is the idea of a community built around software, where many people contribute to it and many people benefit from it," he said.

#### **ENABLING THE FUTURE**

An open community approach must be similarly embraced by the larger GEOINT Community as it builds capacity for the next generation of GEOINT services.

"Geo problems are geo problems. Those problems won't change, but the scale of the data that people can apply to those geo problems is about to go off the charts with the Internet of Things, autonomous vehicles, signals intelligence-you name it," Pickle said.

Therein lies the promise of opensource software: By leveraging the size and diversity of the global developer community, GEOINT enterprises faced with complex data management problems can develop solutions quickly, creatively, and cost-effectively.

"Think about the benefits open source provides. You've got a cost cap because there's no license for the software, you've got the ability to quickly develop systems because the source is open, and you can collaborate in an unlimited fashion," Pickle continued. "Now think about the problems of the future-data fire hoses coming into distributed systems that have many users with varying needs. You just can't solve them without open source."

Layered on top of breakthroughs in automation, artificial intelligence, and cloud computing, the potential is overwhelming.

Concluded Grady: "The global community of developers harnessing the cloud and machine learning, and applying it to new real-time data feeds? Wow. Look out."

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With geospatial information becoming more and more ubiquitous, what is the future of GIS as a term and as a profession? BY ROB PEGORARO

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#### Sea Cliff

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This Esri map shows the density of cooling towers in New York City. By mapping data to hex bins, data clusters and hot spots are revealed.

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Hempstead

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THE NOTION OF the geographic information systems (GIS) profession is becoming increasingly hard to pin down to one point on a map. From one direction, a flood of geospatial data has stressed the abilities of traditional GIS suites to process information and respond to queries. From another, the rise of open-source tools has disrupted the market for traditional systems. And demand continues to increase for geospatially-sourced insight. >>

These converging factors are causing some industry leaders to ask: Does the term "GIS" need to be retired?

"We've gone from GIS priests to GIS practitioners," said Todd Bacastow, a geography professor at Pennsylvania State University. "Before, you were sort of the priest, you knew the magic to make this work. Now these folks are just practitioners."

"Spatial data is just another type of data," summed up Linda Stevens, founder and managing partner of the San Francisco-based geospatial marketing firm 51by1. "There's so much data that people don't even know what to do with it."

#### **OLD TO NEW, BIG TO SMALL**

Where processing and analyzing geospatial data was once a task for dedicated workstations that amounted to a full-time occupation for the professionals who operated them, that work is now likely to happen as one routine among many on a standard computer, tablet, or phone.

"You see veteran GIS professionals saying, 'I can't afford to pay a quarter of a million dollars for a site license," Stevens said. "You can now do geo-coding with Google for free."

The transition evokes the computer industry's shift from mainframe to desktop computers-as well as the more recent migration from laptops to mobile devices. And as with those earlier evolutions, fitting the tool to the task and fitting the task into a budget

Or as Stevens put it, "These developers who are looking for tools they can use to build stuff-they don't have a ton of money."

have played a significant role.

with traditional GIS workflows, has followed this trend from standalone suites to web services as well.

Esri, the vendor most associated

"Over the last five years, our software-as-a-service offering, ArcGIS Online, has grown to over 6.6 million users," said Dirk Gorter, Esri's director of product management, via email. They generate some 50,000 new maps, apps, and layers each day.

Though Gorter did not break down how much of Esri's business now derives from services versus traditional desktop installations, he did say Esri still finds "healthy demand" for its topof-the-line ArcGIS Pro suite.

Stevens-who until 2014 worked as Esri's chief marketing officer-also pointed to the rise of open-source tools for geospatial analysis, as well as the ecosystem of developers around this software. She noted this growth has allowed the emergence of a different business model: support services for companies using open-source libraries and applications, as provided by newer firms such as Boundless.

#### **DIFFERENT SKILLS**

The immediate upside of the transition from standalone suites to web-based tools is faster solutions. Bacastow cited a classroom exercise he's run, in which students have to piece together the last movements of a Baltimore-based attorney who was found dead in Lancaster, Penn., in 2003.

He said work that typically took hours in Esri's ArcGIS desktop suite only requires a fraction of the time in ArcGIS Online.

"I've had students, first-year students, who did it in 15 minutes," Bacastow said.

But moving existing GIS data and applications to these new web services and tools isn't a copy-and-paste job. As an organization transitioning from a traditional LAN architecture to cloud services cannot expect to do so over a long weekend, switching to open-source tools can be even more complicated.

"Implementing an open-source GIS approach has traditionally demanded DIY capabilities that make it beyond the reach of many organizations, and the transition to an open system often required an abrupt, rip-and-replace effort," said Andy Dearing, CEO of Boundless, via email.

According to Esri's Gorter, complex workflows with advanced analytics

are still better suited for desktop applications.

"Migration is more than just software, it's training, workflows, and investment by the whole organization for change," he said.

The vast increase in geographicallytagged data also demands a high degree of data literacy, lest people plug the wrong details into a web tool and be fooled by a pretty-looking result.

"The thing that's worrisome to me," Stevens said, "is you can take two datasets, and with the click of a button, overlay them. But you have no idea if that result is valid. How old is the information? Is it still relevant?"

Having so many newer, web-based tools be open-source-for instance, the community-maintained OpenStreet-Map project—can further complicate a move from legacy GIS tools. Confusion may be more likely for professionals used to the strict boundaries and topdown direction of commercial licensing who may think of open-source development as its polar opposite.

"People think of open-source as a free-for-all, but it's not," Stevens said. "It's very organized."

She advised traditional GIS practitioners to get acquainted with web-based and open-source ecosystems by attending events such as the FOSS4G conferences hosted by the Open Source Geospatial Foundation.

A benefit of this evolution, Dearing said, is the opportunity to do more than hand off geographic data to decision-makers.

"The trade will change, where you will no longer have geospatial analysts only making maps; the trade is shifting to have analysts perform what their title says-analysis," Dearing wrote.

For those who don't evolve, there's risk of occupational irrelevance.

"Someone will take those processes-it could be Google, it could be somebody else-will take those processes and build them into something that doesn't require the study of a priest to use them," Bacastow said. "The number of people you'll need for the priesthood will diminish."

Stevens noted one way that situation can resolve itself.

"There's going to be a lot of people who will be retiring soon," she said.

Geospatial educators face their own challenge in keeping up, Bacastow noted.

"By the time this trickles down to educators, we're oftentimes the last

Online generates some 50,000 new maps, apps, and layers each day.

ArcGIS

IMAGE COURTESY OF S&P GLOBAL PLATTS

ones to identify what's happening to a market and how we change what we teach," he said.

#### A NAME CHANGE FOR A GAME CHANGE?

The GIS profession's ongoing transition can be seen in the micro-geography of office buildings.

"You [used to] have a GIS office, and everybody would go to the GIS office to have spatial things done," Bacastow said. "That is gone."

The nomenclature is changing as well. "GIS" as a term for this profession and practice is ebbing in favor of newer phrases such as "location intelligence" and the more generic "business intelligence." Google's Ngram Book Viewer, which tracks the incidence of words and phrases in published books, shows that use of "GIS" peaked in 2002; "location intelligence" and "business intelligence" have taken off since 1998 but still remain less popular than the older term.

The magazine *GIS Professional* announced in October that it would end its printed edition, a decision editor Niall Conway blamed in part on the decline of GIS as a recognized term. "As maps have become more mainstream and accessible, GIS has become a less easy-to-define field to explain to other non-GIS folk and to, therefore, promote as the discipline which it once was," he wrote.

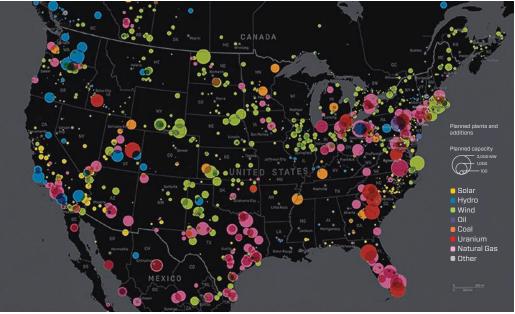
Gorter said Esri now sees distinct markets for traditional GIS, location intelligence, and spatial business intelligence. Industries such as finance, natural resources, and utilities are particularly likely to opt for Esri's service offerings.

Bacastow suggested GIS may soon no longer be its own specialty.

"All those concepts will be absorbed someplace," he said, and warned, "someone will lose, and that's a person who had their profession tagged as GIS."

Stevens posited the traditional definition has earned an honorable retirement. She compared it to database giant Oracle's transition from being known as a relationaldatabase vendor to a company that builds applications. In GIS, the same thing is happening—even as the fundamental concepts remain as relevant as ever.

"There are still GIS professionals who are building data," she said, adding that the description for their work



This map highlights the changing power generation fuel mix in the United States. Maps showing the spatial distribution of power generation document the regional effects fuel costs and consumer trends have on the changing landscape.

### PERSPECTIVES ON THE FUTURE OF GIS

"While GIS might not be considered as special as it once was, as location information is coming to the forefront of mainstream IT, there is still a science in understanding how to make effective decisions and drive deeper understanding and meaning as to what the data can tell you." — Andy Dearing, CEO, Boundless

"Traditionally the GIS professional is curating data, developing advanced workflows, providing deep analytics, creating beautiful cartographic products, or answering hard questions that appear, perhaps, as a dot on the map. Esri wants to ensure the contributions of the GIS professionals behind the scenes isn't lost by 'GIS-as-aservice." — Dirk Gorter, director of product management, Esri

"We can be, as educators, really years behind the needs of the market. I will tell you I think it's happening in the GIS world right now." — Todd Bacastow, professor, Penn State

"Now that there's so much data available, we need to go to the next level: How do we take spatial data now that it's available and use it for problem solving?" — *Linda Hecht, founder, 51by1* 

"Locational intelligence has become a new frontier of opportunity for many industries and the geospatial knowledge and skills that our industry possesses has almost limitless potential." — *Niall Conway, editor,* GIS Professional (*from a note announcing the end of that publication's printed edition*)

will vary by industry and client. But what do you call their work?

"You have location intelligence, which is more for business. You have LBS, which is location-based services. I don't know if I have a preferred [term]." By any moniker, these capabilities aren't going away, and the demand for them is only increasing.

"It's going to be part of everything we do," Stevens said.

But the name or names the capabilities will eventually bear are yet to be determined. ④

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#### Perspecta: Experience Never Looked So New

Q&A with Kent Matlick, senior vice president and general manager, Intelligence Group

#### What challenges does Perspecta help its customers solve?

Perspecta was formed in June as a spinoff of DXC Technology's U.S. Public Sector business combined with two private equity-backed companies owned by Veritas Capital—Vencore and KeyPoint Government Solutions. The company's Intelligence Group can be traced back through Vencore to Lockheed Martin and General Electric.

We serve federal customers including the Department of Defense, civilian agencies, and all members of the Intelligence Community. Our intelligence work originated in 1972 doing end-toend systems integration on a program with the National Reconnaissance Office. Our geospatial work dates back to the Defense Mapping Agency and the National Photographic Interpretation Center, leading up to our work today with the National Geospatial-Intelligence Agency (NGA). We're proud of that legacy.

One challenge for our customers is transforming legacy systems to cloud-native systems. Everyone wants to leverage the efficiencies and cost savings associated with the cloud, but that is sometimes difficult and complex. We use Model-Based Systems Engineering to improve integration and reduce timelines.

Another challenge is aligning budget and IT via business architecture to assess return on investment. We provide a dashboard that uses an agile management approach to link strategy, missions, capabilities, value streams, and solutions. Finally, some of our customers need to integrate increasingly diverse and complex sources across a globally distributed cloud-scalable architecture. We offer high-fidelity modeling and simulation tools for collection and data flow analysis as well as predictive modeling.

What differentiates Perspecta with regard to intelligence systems engineering and data analytics? We've been doing this a long time. One of my favorite lines we've



Kent Matlick

used since becoming Perspecta is "experience never looked so new." This speaks to both our long legacy and our innovative spirit. One differentiating aspect relates to our acquisition of one of the Bell Labs businesses in New Jersey, which is now Perspecta Labs. They do deep, innovative, and applied research in areas like cyber, cloud, and quantum for organizations like the Defense Advanced Research Projects Agency (DARPA).

We're also working on big data and machine learning. Two years ago, we used an innovative, open-source advanced analytics technique to monitor activities in Syria and provide intelligence for a number of agencies. In his September 2016 remarks to the Senate Select Committee on Intelligence, NGA Director Robert Cardillo stated, "The program also serves as a testbed for future ceasefire monitoring around the world, with a goal towards placing fewer peacekeepers' lives at risk."

#### What are some steps that organizations can take to improve their systems integration or data services?

Recognize the value of establishing an approach, a budget, and a schedule. Many companies jump into agile solutions with little to no outline. Agile definitely has its advantages, but it is not the end-all. You have to know what you want out of it.

At Perspecta, we have adaptive systems integration methods that mix agile, spiral, and traditional methodologies to balance flexibility. The market is jumping from traditional legacy systems to cloud systems, and what's popular now are hybrid clouds—a mix of architecture approaches. It takes a fair amount of diligence and understanding for a company to define what that means for them. You need to know the range of operations in your customer base to make sure you're servicing everybody correctly.

#### How are you leveraging emerging technologies to better serve your clients?

Perspecta Labs has a program with DARPA called Learning Using Privileged Information. They have developed a unique machine learning paradigm that enables learning from heterogeneous data and provides higher accuracy than classical supervised machine learning. This is a promising approach that can be applied to image assessment and production.

Also, our Risk Decision group is developing a risk assessment tool called PrimaryGlass, which uses predictive analytics and machine learning to create pattern-of-life profiles. These profiles can be used in both continuous evaluation and insider threat programs.

#### What excites you about the future of geospatial technology?

There are so many possibilities. I recently read a New York Times article about mobile apps and location tracking. For now, that technology is primarily focused on selling data to advertising companies, but think about the future. Everything will be tagged and portrayed on a geospatial plane. Making this data available to

"One challenge for our customers is transforming legacy systems to cloud-native systems. Everyone wants to leverage the efficiencies and cost savings associated with the cloud, but that is sometimes difficult and complex. We use Model-Based Systems Engineering to improve integration and reduce timelines." the government's background investigators, like some of my Perspecta colleagues, will enable a "trusted workforce" construct and may even eliminate the security clearance backlog. And given the shortfall in cleared talent, it could help us find the folks we need to continue to advance the industry. This is an exciting time.

#### Woolpert: A New Paradigm

*Q&A with National Security Project Manager Tim Hale* 

What is Woolpert's history in the GEOINT Community? Woolpert was founded in 1911 and is based in Dayton, Ohio. Fittingly, surveying was the original service offered. Today we are a unique AEG (Architecture, Engineering, Geospatial) firm that delivers value to customers by blending our engineering pedigree with leading-edge geospatial applications.

We work with international customers as well as federal, state, and local governments and private industry. We've expanded our international reach in the last several years, not just in defense and national security but also in civil government and nongovernmental organizations. Many are surprised to discover we have customers on every continent. Specific to national security, we work with U.S. defense and intelligence organizations including military branches, combatant commands, and federal agencies.

What differentiates Woolpert from similar organizations? AEG is a new acronym we coined and a distinct departure from the AEC (Architecture, Engineering, Construction) paradigm. AEG communicates the value of geospatial information to our customers when paired with our other services. Our geospatial sector acts as a great enabler and connecting force. As a result, we're recognized as an information firm that can work demanding projects with diverse requirements from initiation to completion.



High-resolution orthoimagery taken over the African country of Niger. Specific to the geospatial sector, we do much more than provide accurate mapping data. We have our own survey teams, a fleet of aircraft and sensors, data processing centers, and mature photogrammetry, GIS, and mapping teams. We round that out with sensor research and development, application development, cloud services, and a Woolpert Labs innovation group.

#### What innovative geospatial initiatives do you have in development?

We have a fantastic program focused on global commercial airborne services, which provides high-resolution imagery and 3D geospatial information. We have worldwide collection capabilities as well as the capacity for rapidresponse mobilization, prompt production, multilevel product generation, and online data dissemination "We have our own survey teams, a fleet of aircraft and sensors, data processing centers, and mature photogrammetry, GIS, and mapping teams. We round that out with sensor research and development, application development, cloud services, and a Woolpert Labs innovation group."

- TIM HALE, WOOLPERT

and hosting. The heart of the program is executing projects in a structured and cost-conscious manner with a focus on minimizing risk and maximizing value.

We're also investing in our "Blue Economy" initiative, which recognizes the importance of sustaining the world's waterways, coastlines, and associated infrastructure. We

provide airborne bathymetric LiDAR services, hydrographic surveying, and shoreline mapping for our "blue" market customers, and work extensively with various organizations to provide services that will benefit navigation safety, climate science, renewable energy, environmental protection, and homeland security.

You serve a wide range of markets—what is the importance of integrating GEOINT outside of national security? Repositioning ourselves as an integrated AEG firm and seeing the positive response to this new paradigm speaks volumes to the importance of geospatial in our non-defense markets. Every non-defense discipline within Woolpert uses large components of geospatial information. Take, for example, innovative programs happening at civilian agencies and the proliferation of location-based services. The integration of GEOINT in non-traditional markets is a natural evolution of the technology.

How are next-generation technologies like machine learning and cloud infrastructure shaping Woolpert's offerings? Both of those have become major components of our geospatial capabilities. Value-added intelligence continues to be of prime interest to our customers, as does data storage and distribution. Traditional products like imagery and point clouds are fantastic, but customers have huge interest in feature identification, route networking, automated tagging, and similar applications. The same customers are interested in using cloud services to host data, process analytics, and make it accessible as the volume of data and its uses grows.

What excites you most about the future of GEDINT? First is the incredible rate of technological advancement. The improvement of each new sensor and collection platform is astonishing. Coupled with advancements in automated processing, machine learning, and cloud services—what a powerful combination that is. We are in a golden age of geospatial advancement.

Second is the interest I've seen from young people. It's fun to work alongside organizations like ASPRS, USGIF and its Young Professionals Group, and high schools and colleges with STEM and career technical programs. It's great to see the interest and excitement on young faces when they realize how impressive geospatial technology is.

Tim Hale

#### Data Management is a Team Sport

*A conversation with David Grosso, senior geospatial analyst at Tesla Government* 

David Grosso joined Tesla Government in 2015 as a geospatial analyst turning data into mission-ready intelligence. His original responsibilities were to create interactive and static products using geospatial software and to establish data management standards to reduce the duplication and use of antiquated data. In 2016, when Tesla began expanding its GIS team, Grosso was promoted to senior geospatial analyst. In this role, Grosso helped develop a dynamic, intelligent folder structure to organize and maintain centralized data. He currently ensures data quality and maintains standards for data processes his team uses to complete tasks including communication, product development and design, and branding.

#### How do you keep pace with the rapid evolution of best practices in data management and analytics?

It's really situational. Awareness of best practices depends on your focus area and interests. You don't realize something is wrong until you face the problem. And when you do, instead of ignoring the problem, it's best to address the issues head-on. Then you find what methods are being employed, which software is being used, and what research is being published. Once new information is available, you try to implement those improvements.

It's a dynamic process that requires you to think critically. I absolutely lean on the rest of my team to be a part of this. I always get feedback and make sure everybody is comfortable with major changes. It is imperative to rely on their expertise when making programmatic decisions that will affect the team's ability to produce. In many cases, we implement changes we all agree upon, and if we ultimately don't like the change, we scrap it and try something else. As a whole, we push out more products each month than we did the month before. Those products are constantly improving in quality and standardization, while being more user-friendly.

#### What is your advice for aspiring GEOINT professionals?

Find a mentor, someone who knows the industry with years of experience. For me, that person was John Steed, Tesla's director of Geospatial Services. Not only has he allowed me to follow my heart and learn new skills, he has encouraged me to find ways to implement those skills in the workplace.

Programming skills are a must these days. If you have any front- or back-end programming skills that can be used to refine products, add capabilities, and automate, you will certainly set yourself apart. Programming skills will also lend you the ability to learn new languages that will be critical in the future. Even outside of the geospatial community, in the commercial sector at large, the ability to automate and program is critical.

Finally, stay in the know. Be aware of what is happening in the greater community and specific to your field. Read the publications—*trajectory* is a great example. Read anything public coming out of NGA. Know what software is being used, what's cuttingedge, and what techniques contractors and the government are using. Equally as important is learning about companies that are not achieving their goals and finding out what didn't work and why.

# What are the challenges you face as an analyst in the era of big data?

Misinformation is a big challenge. You never want to make assumptions. There are always technological limitations, but the bigger issue is probably operator error. What are the mistakes you, the analyst, are making? Always get somebody to proof your work and make sure it makes sense to them. You could spend a month laboring on a project and fall so deep into it that "It's a dynamic process that requires you to think critically. I absolutely lean on the rest of my team to be a part of this. I always get feedback and make sure everybody is comfortable with major changes. It is imperative to rely on their expertise when making programmatic decisions that will affect the team's ability to produce."

- DAVID GROSSO, TESLA GOVERNMENT

you don't see where you're making mistakes. Be ready to grow from your mistakes and adapt to new processes, methods, and technologies.

#### How has USGIF membership contributed to your professional growth?

It's definitely made my bosses happy. They're thrilled that I've pursued involvement with the organization, and with the work I've done on improving and developing content for USGIF's Essential Body of Knowledge. We've grown a nice relationship with USGIF here at Tesla Government, one we would love to continue. We've also hosted a USGIF **GEOINTeraction Tuesday** event and students from the Foundation's Externship Program. In an industry that revolves around information and intelligence, it is so important to share and grow together. 🕲

David Grosso

# horizons

### READING LIST

# T H E SECRET WORLD

A History of Intelligence

# CHRISTOPHER ANDREW

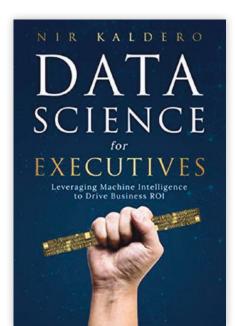
BEST SELLING AUTHOR OF The Sword and the Shield

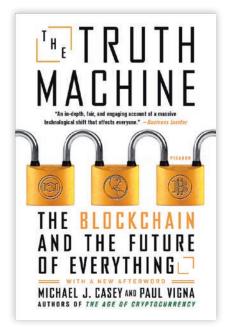
#### *The Secret World: A History of Intelligence* By Christopher Andrew

Authored by professor and historian Christopher Andrew, this book is among the most comprehensive written histories of global espionage a profession older than many may realize. This account looks to ancient history, from Moses to Sun Tzu to the Napoleonic Wars, to glean insight about how intelligence agencies today can operate more effectively and efficiently.

#### Data Science for Executives: Leveraging Machine Intelligence to Drive Business ROI By Nir Kaldero

Companies must take advantage of any competitive edge to maintain success, and in today's explosion of artificial intelligence and machine learning, late adopters will be left behind. Data Science for Executives provides practical strategies for companies to drive profits by harnessing the power of machine intelligence and big data. The book includes case studies and workshops to help readers understand and apply foundational concepts of data science to their own workflows.





#### The Truth Machine: The Blockchain and the Future of Everything

By Michael J. Casey and Paul Vigna

Though Bitcoin and other cryptocurrencies remain controversial, the blockchain technology behind them possesses universally disruptive potential. In their second co-authored book, Vigna and Casey explain how the blockchain represents a new era of personal data security and how the technology has the potential to impact society and the global economy. The effects are far-reaching, and predicted to inspire major shifts in finance, shipping, intelligence, and beyond.

### USGIF EVENTS CALENDAR

FEB. 19-20 Small Satellite Workshop NGA Campus East, Springfield, Va. MARCH 12 GEOINTeraction Tuesday Northern Virginia MAY 14 GEOINTeraction Tuesday Northern Virginia JUNE 2-5 GEOINT 2019 Symposium San Antonio, Texas The U.S. Defense Department and the Office of the Director of National Intelligence selected **REAR ADM. ROBERT SHARP** as the next director of the National Geospatial-Intelligence Agency. Sharp will assume command of the agency from current Director **ROBERT CARDILLO** during a ceremony in February.

Vectrus appointed **KEVIN BOYLE** senior vice president, chief legal officer, and general counsel. He will deliver innovative solutions to complex legal, business, and regulatory issues.

The Defense Innovation Unit welcomed **MICHAEL BROWN** as its new managing director. Brown has experience in hardware and software at Quantum and Symantec.

38 North announced the expansion of its imagery analysis staff. **IRVIN BUCK** and **PETER MAKOWSKY** joined the organization, which studies and reports on events in and around North Korea, as commercial satellite imagery analysts.

The U.S. Army chief of staff appointed **MAJ. GEN. CHARLES H. CLEVELAND** director of operations and military deputy for NGA. Cleveland was formerly vice director for intelligence J-2 at the Defense Intelligence Agency.

Leidos named **TIM FREEMAN** senior vice president of business development and strategy for its defense group. Freeman will lead strategic development, new business capture, and financial strategies. Jacobs announced three executive appointments. **MARIETTA HANNIGAN** was promoted to the new position of chief strategy and communications officer. **DARREN KRAABEL** was promoted to the role of chief technology and innovation officer. And **MADHURI ANDREWS** joined the company as chief information officer.

Spatial Networks announced the addition of **BRIAN MONHEISER** as executive vice president for government solutions — global. Monheiser will deliver Spatial Networks products to the U.S. federal government, NATO, the United Nations, and other international governments and organizations.

Peraton appointed **ALAN STEWART** executive vice president and chief financial officer. He will be responsible for the company's financial planning, accounting, government reporting, and auditing functions.

ManTech promoted **YVONNE VERVAET** to senior vice president of growth and capabilities. She will establish growth strategy by ensuring business methods, capabilities, and technologies align with federal budgets and the company's pipeline. The company also appointed 16-year Northrop Grumman veteran **JOHN MCNIFF** to its mission, cyber, and intelligence solutions group as senior vice president for business development.

Former Deputy Secretary of Defense **ROBERT O. WORK** joined the MITRE Corporation's Visiting Fellows Program. The program invites nationally recognized leaders to work as advisors with MITRE.

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# NetApp

# perspective

### CHAMPIONING GEOSPATIAL DATA

*Executive Director Ivan DeLoatch on the changing role of the Federal Geographic Data Committee* 

With the passing of the Geospatial Data Act (GDA) in October 2018, the Federal Geographic Data Committee (FGDC) will have a new reporting line. Organized under the U.S. Office of Management and Budget and chaired by the Secretary of the Interior, the committee will now also report biannually to Congress.

FGDC Executive Director Ivan DeLoatch welcomes the interaction with the legislative branch. Even as the FGDC combs through the GDA to further understand what its purview will be, certain aspects of the committee's mission managing federal geospatial resources—will remain the same.

How does the GDA affect the FGDC's mission? For two decades, various administrations have seen the value of what we do, and now the legislative branch does as well. State and local governments have communicated their needs to Congress, but because of the way our committee was structured legally under the executive branch, we could not always communicate directly with those bodies.

The FGDC has the foundation in place to accelerate the pace of current initiatives, and the GDA represents an opportunity to demonstrate how those resources were invested and to identify where more resources are needed to advance the National Spatial Data Infrastructure. Our stakeholders recognize that we have certain resources to implement our plans for infrastructure, but that we are operating in a challenging business environment. The FGDC wants to ensure the programs it oversees can overcome certain barriers to efficiency.

### Can you describe some of the geospatial data assets you oversee?

One stated goal of government stakeholders is the modernization of IT in general and managing geodata as a strategic asset specifically. As part of the National Geospatial Data Asset (NGDA) Management Plan, the FGDC has identified 177 core national datasets it manages. Analysis and management of these datasets allow various stakeholders to understand the health of or gaps in the datasets, while at the same time minimizing costs and preventing duplication.

The amount of data available is staggering. Private individuals, businesses, the military, and GEOINT sources are capturing huge volumes of information every day. And yet, there are tasks that still need to be accomplished. The GEOINT Community Workforce Development Program launched GeoPathways in concert with the State Department, inviting students to assist the department on projects in



topics such as water management, natural disasters, and other environmental concerns. Participants conduct studies in virtual environments. Outside of that program, other citizens are crowdsourcing enormous amounts of useful geodata, though verification of that data presents a significant challenge.

#### You've previously spoken about "closing the gap between gatherers and users" of geospatial data. How is the FGDC facilitating this?

Access to the collaborative NGDA environment requires shared, uniform data management and data management practices. Setting standards for data management is a cornerstone of the work we do. For more than 10 years, we have worked with the Open Geospatial Consortium, the Geospatial Intelligence Standards Working Group, and others to promote standards adherence to allow for more effective information sharing.

Folks are starting to see the value in standardization. So many interfaces will be driven by user experience, so as geodata systems are implemented across government, we want users to experience it as a valuable and reliable commodity. Plus, it could save agencies time and money—it makes sense to evaluate existing platforms before going out to build another one. The spatial data infrastructure has the potential to be a grand integrator of socioeconomic, financial, statistical, and environmental data.

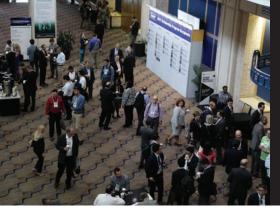
Could you talk about some of the international groups you work with to develop their geospatial data infrastructures? Geospatial data management does not stop at U.S. borders. The FGDC is part of an intergovernmental group of 105 countries and 125 participating organizations working to implement architectural principles to share data globally through Global Earth Observation System of Systems. This will allow the U.S to share select data and gain access to data collected by international sources.

The FGDC also has a United Nations (UN) Global Geospatial Information Management Working Group that develops reports for the United States Member State dossier. The group reviews and reports on geospatial data identified by the UN in fields such as climate change, disaster management, and more—again with the goal of non-duplication. This activity is of great benefit to the U.S. in many areas, both strategic and financial.

### What are other goals the FGDC is working toward?

We need to improve outreach so agencies understand what data they can access. I recently briefed the Federal CIO Council and some members didn't know the extent of geospatial data available. The FGDC and other geospatial champions believe data drives the economy and there is a vast reservoir of information waiting to be tapped.

As more federal departments are required to incorporate geospatial data in their reporting under the GDA, that reservoir and awareness of it will grow. *Data.gov* is a space for sharing unclassified geospatial data and is a vehicle for transparency and open government. Ultimately, this will improve the lives of citizens. The GDA will be a shot in the arm to prioritize geospatial information and show that it is a bigger, more important resource for the public as well as for business, the executive branch, and Congress.



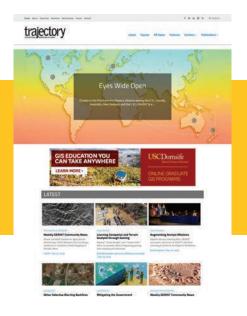
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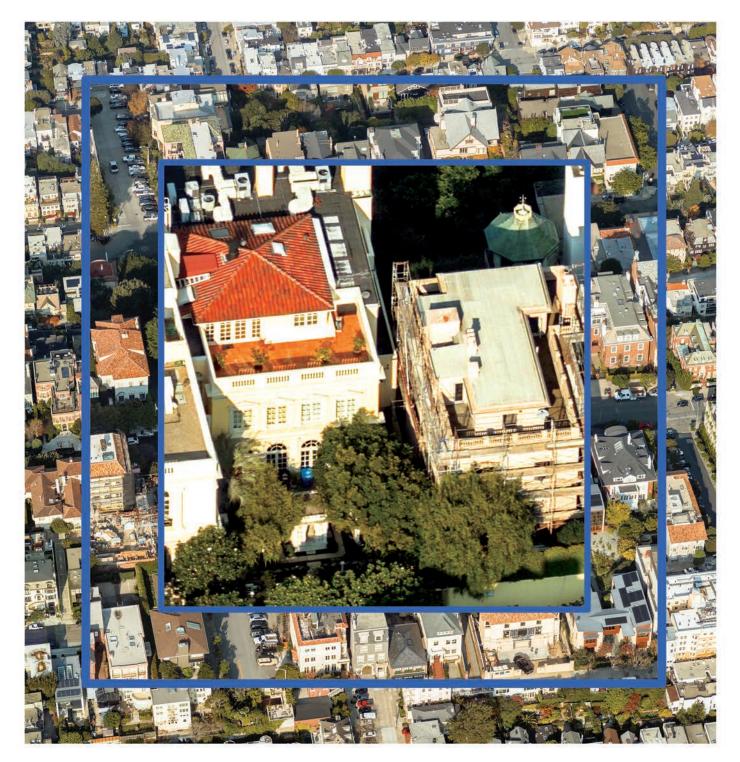




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