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Publisher of



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**OUTLOOK
2017**

40 FORTY
UNDER

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GEOSPATIAL
Professionals

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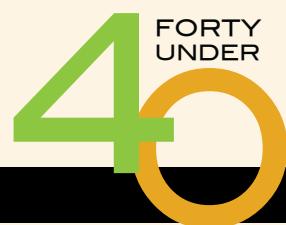
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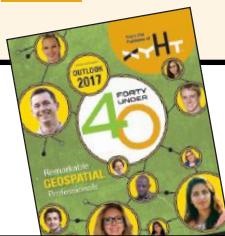
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Every person on our cover is a highly dedicated geospatial professional under the age of 40. Nominate a candidate for next year's edition by emailing 40under40@xyht.com.



Outlook 2017

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FINDING YOUR VOICE

WELCOME TO XYHT'S OUTLOOK

2017, the 40 Under 40 (40 < 40) special issue. You have here a valuable resource. Be prepared to visit the future of geospatial: featured within are the upcoming leaders of our profession.

Unless you are lucky enough to have one of these individuals on your staff, they are your competitors. If you are anything like me, that is not a scary thought—that is exciting! Competition demands I be better tomorrow than I am today. I am thankful for individuals such as these to inspire me.

As I read the 40 < 40 profiles, several common themes emerge. Almost all of these professionals are college-educated, many with advanced degrees. Most volunteer their time to geospatially related non-profits—meaning, they show up. These are not simply jobs; these are careers. Many have traveled globally: a multi-national or global vision reflects in their work. They all use state-of-the-art technologies.

The sum of these parts—and the biggest distinction—is that they have found their voice.

Are you under 40, dreaming to make it on this list? The key ingredient is simple yet challenging. You must find your voice, that fire in your belly that inspires you. Passion moves people. Passion changes the world. The quest for your voice will either open the richness of your profession or indicate a need for change.

The quest for your voice will either open the richness of your profession or indicate a need for change.



With passion, the term "work" loses its negative trappings. It is liberating when the ideas of career and hobby become indistinguishable. Be mindful that all work has elements of drudgery, but engagement should outweigh routine.

If you are an employer looking for superstars, my advice is nearly identical. Create a culture that enables your staff to find their voices. Also, have the courage to let go of the employees obviously not engaged. This can be difficult. You have to be honest with yourself. Are you building a high-performance team, or are you building a family? Teams, while certainly exhibiting many family qualities, know how to release the anchors to their greatness.

Within is also "Boom Behind/

"Boom Ahead" by xyHt's editor, Gavin Schrock, detailing the impact the Millennials—some herein—will have on the geospatial profession and related industries.

Sociologists have been developing a general snapshot of Millennial attitudes, and there are two that are oft repeated and relevant to this discussion: Millennials need a sense of community, and Millennials want to know their work has meaning.

This is a powerful combination with high expectations.

The Millennials want to belong to something where everyone contributes equally. Having previously paid your dues has little currency. What you are doing today to support the mission means everything. From the Millennial perspective, a community should not hold its members down; it should lift them up. The biggest contribution a seasoned leader can provide, and should provide, is to help the younger staff find their voices.

This brings the discussion back to the start: It is difficult to find your voice if you are humming the same, tired songs. Finding your voice is easier when you are working with new tools and new modalities, like our 40 < 40. The surest way to protect, preserve, and promote the geospatial professions is to place the latest tech in the hands of our future leaders, encourage and support their educational pursuits, ultimately help them find their voices, and let them sing proudly. ■



James M. Shaw, Jr. is a Maryland licensed professional land surveyor and a geomatics project manager at the Annapolis Junction, Maryland branch of Greenman-Pedersen, Inc. where he heads up mobile lidar and terrestrial lidar projects. He is also a past-president and the technology chair for the Maryland Society of Surveyors and a contributor to xyHt.



PAULA DIJKSTRA

**REGIONAL MANAGER AT
KADASTER INTERNATIONAL**

NETHERLANDS

AS A YOUNG GIRL, Paula dreamed of helping make the world a better place. Now she views it as privilege that—in her role with the Netherlands' Cadastre Land Registry and Mapping Agency (in short, Kadaster)—she can contribute to achieving the sustainable development goals of the United Nations. Paula says, "Reliable and easily accessible geo-information will help society in many ways. Education is an important aspect."

Paula was project manager of the GeoSkills Plus project, wherein eight partner organizations developed a cooperation model to address the mismatch between the needs of the geospatial sector and the education sector. From 2012 until 2016 Paula had a leading role in building the global Young Surveyor Network community. As vice chair of the network she enjoyed working with young international colleagues, promoting open discussions about innovative approaches with new tools and technologies. Paula organizes meetings, helps shape next steps, and travels. She organized FIG Young Surveyors conferences and regional meetings in Lisbon, Kuala Lumpur, Sofia, Minneapolis, Christchurch, and Amsterdam.

Paula obtained an MS in social geography. At Kadaster, she is responsible for international projects in the Central and Eastern European region and joint projects of Kadaster and the Global Land Tool Network, where she works with land administration agencies to understand and apply practical ways to provide secure land rights and records.

STUART WARNOCK

OWNER AND PRESIDENT OF PIONEER MAPPING

TEXAS, USA

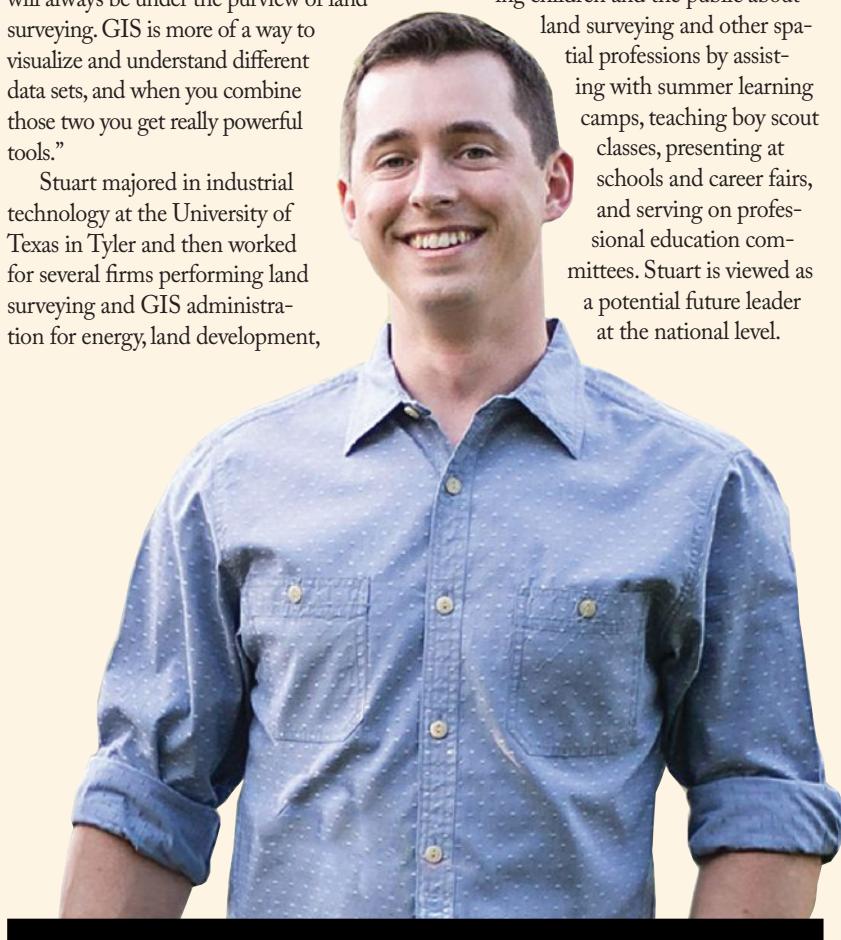
STUART WARNOCK is a registered professional land surveyor and a GIS professional who is making his mark on the surveying community, professional associations, and education outreach for the professions. The name of his firm, Pioneer Mapping, is a nod to a broader view of the types of services surveyors provide. Stuart said, "Surveying is not going away, and neither is GIS. They serve different needs but complement each other. There will always be a need for the cadastral side of things—boundary dispute resolution, records research, case law—that will always be under the purview of land surveying. GIS is more of a way to visualize and understand different data sets, and when you combine those two you get really powerful tools."

Stuart majored in industrial technology at the University of Texas in Tyler and then worked for several firms performing land surveying and GIS administration for energy, land development,

and construction clients. He developed as-built surveying and GIS data-management solutions for corporate asset management, and he organized surveying and field engineering support for as-built, topographic, and construction staking operations. Just over a year ago, he founded his own company.

Stuart has become well known in the surveying community locally and nationally, working in education and outreach efforts and serving as a Texas delegate to the NSPS Young Surveyor's Network. He has been heavily involved in education

children and the public about land surveying and other spatial professions by assisting with summer learning camps, teaching boy scout classes, presenting at schools and career fairs, and serving on professional education committees. Stuart is viewed as a potential future leader at the national level.



RAYNAH KAMAU

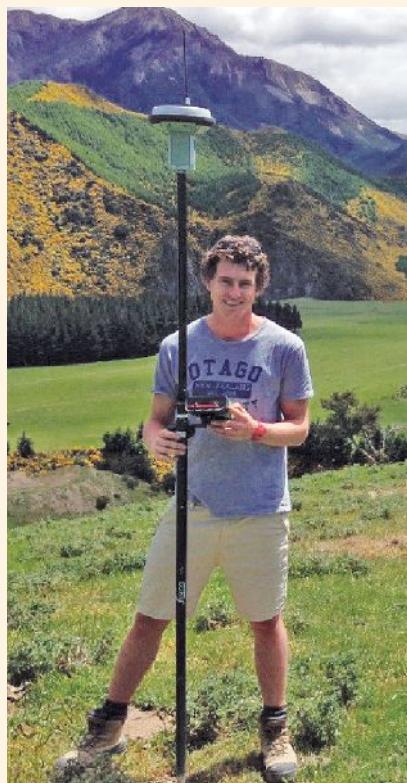
TECHNICAL SUPPORT ANALYST AT ESRI

CALIFORNIA, USA

WITH ABOUT 40% OF THE GLOBAL MARKET FOR GIS SOFTWARE,

WARE, Esri serves hundreds of thousands of customers—at all levels of skill and experience—who put pressure on technical support specialists. These specialists are the unsung heroes who often make the difference between your project's success and failure. Chances are that the specialist on the other end of the support ticket has a wealth of education and experience, just like Raynah Kamau.

Earning her degree in geomatics and GIS from Jomo Kenyatta University of Agriculture and Technology in Kenya, Raynah served as a surveying intern for several private firms, then as a GIS intern for the Ministry of Finance—where she worked on a project to map various districts and their respective stimulus projects to enhance transparency and accountability in the use of public funds. She then took an internship and the positions of web-mapping developer and GIS analyst for Esri (Eastern Africa). Raynah later traveled to Redlands, California, to earn her MS and joined Esri there as a support analyst.



MARK CHRISTOPHER MYALL

DIRECTOR OF MYALL & THURLOW CONSULTANTS LTD NEW ZEALAND

HAVING GRADUATED FROM THE UNIVERSITY OF OTAGO in 2010 with a Bachelor of Surveying with Honors First Class, Mark Christopher Myall is a licensed cadastral surveyor in Christchurch, New Zealand. He started his professional career with an international multidisciplinary engineering consultancy where he was involved in the legal surveying of large-scale subdivisions. Following the devastating Canterbury earthquakes of 2010/2011, Mark was heavily involved in a diverse range of surveying to aid in rebuilding the city. Although it was a difficult time, a highlight of Mark's career was working directly with the New Zealand Fire Service, Civil Defense, and Urban Search & Rescue teams to monitor collapsed buildings for deformation while the rescue operation was undertaken.

In 2014 Mark was admitted as a full mem-

ber of the New Zealand Institute of Surveyors and was awarded the Percy Dyett prize for engineering. Mark was on the local organizing committee for both the FIG Working Week in Christchurch 2016 and the 2016 FIG Young Surveyors Conference.

It is incumbent on the bright young leaders in the profession to take bold steps and provide leadership by example. Peer surveyors say that Mark takes new projects, methods, and technologies full on or, in local parlance, "gives it heaps." In December 2015, Mark co-founded Myall & Thurlow Consultants Ltd where he is a director and principal surveyor completing surveying services for a loyal client base. Mark is an active member of both the NZIS and FIG and has a keen interest in new technologies and the young surveyors network.

SAMI MANTERE

CADASTRAL SURVEYOR AT NATIONAL LAND SURVEY

FINLAND

SURVEYING MAY BE TURNING HIGH-

TECH, but often a major part of the appeal to join the profession comes from an appreciation of land and nature. Sami Mantere hails from a small village in northern Finland, where his hobbies were based on nature; nowadays hunting and trekking prominently feature in his life. Having an interest in maps, Sami had a very clear vision of being a land surveyor. He graduated with a BS and an MS in engineering from Rovaniemi University of Applied Science.



After graduation, Sami worked for a private company for three years and since has been working with cadastral issues as a civil servant. His duties are parceling, border reconstructions, and private road proceedings. An internship with Dutch Kadaster in 2011 inspired him; he familiarized himself with different functions of Kadaster, especially cadastral proceedings. This internship led to Sami's participation in the FIG Young Surveyors Network. He was nominated by several YSN peers who cited his fresh and practical perspectives. His advice to young surveyors and those considering entering the profession is to "be active in such organizations—and get involved internationally."



DANIELLE SMILOVSKY

REMOTE SENSING SCIENTIST AND
GIS ANALYST AT AMEC FOSTER WHEELER

ARIZONA, USA

WITH A BS IN ECOSYSTEM SUSTAINABILITY AND AN MS IN GEOGRAPHIC INFORMATION

SYSTEMS, Danielle Smilovsky uses GIS and remote-sensing applications to study and analyze ground deformation around the world. She specializes in performing geotechnical land subsidence investigations using InSAR, SAR, lidar, and water data analysis to study mines, landslides, subsidence, recharge, earth fissuring, flood control structures, and various types of facilities and transportation structures. She's used to working with big, complex datasets!

Last year Danielle presented a pilot study of a major subsidence feature in the Phoenix area using InSAR at the NASA Ames Research Facility, Moffet Field, California. Active SAR users around the globe were invited to collaborate about the new NISAR satellite mission to help construct a five-year roadmap of ideas, improvements, and events to guide the NISAR project leading up to the launch.

Danielle also runs the sustainability program for the Arizona offices on behalf of Amec Foster Wheeler, focusing on office improvement projects, environmental improvement and community outreach efforts, and social sustainability engagements.

Danielle is an active member and the vice-chair of the Association of Environmental & Engineering Geologists, Phoenix Chapter.

NIKOLAS SMILOVSKY

MAPPING DEPARTMENT MANAGER AT BPG DESIGNS

ARIZONA, USA

NIKOLAS SMILOVSKY ATTENDED THE UNIVERSITY OF FLORIDA for a BA in history, but lateral studies instilled an affinity for geography. Anthropology and archaeology classes culminated in a semester abroad in Italy, sharpening his skills in GIS and CAD. Following college, he worked as an archaeologist, performing excavations and completing related digital mapping projects. While working in the Phoenix area, Nikolas attended Arizona State University for a Masters of Advanced Study in GIS. ASU invited him to be a part-time associate faculty member, teaching classes in analytical cartography and data technologies; he has been instructing and working full time for the last seven years.

Nikolas also earned and completed accreditation as an ISA-certified arborist and a certified geographical information systems professional (GISP). His work in academia and private firms has built his reputation as a rising star in



the region's geospatial community. Currently Nikolas serves as the mapping department manager at a company that specializes in utility and telecommunication infrastructure. He uses technologies such as lidar, remote sensing, UAS, and GIS. Nikolas also was recently elected secretary of the central chapter of the Arizona Professional Land Surveyors Association.

By leveraging specialties in mapping, cartography, computer programming, and spatial statistics, Nikolas explores the connections between spatial correlation and cognition. These mental representations of physical places were coined "Cognitive Maps" by psychologist Edward C. Tolman. Nikolas would like to further his studies in this field by augmenting and testing them with new technologies and devices such as Microsoft HoloLens. He is married to fellow 40 under 40 honoree Danielle Smilovsky; they are a well-known geo-power-couple in the southwest U.S.



DAVID P. ACOSTA

PRESIDENT OF CONSTRUCTION SURVEY TECHNOLOGIES, INC. NEW MEXICO, USA

DAVID ACOSTA RECEIVED HIS BS in surveying engineering in 2007 at New Mexico State University and now is a licensed professional surveyor as well as president and co-owner of Construction Survey Technologies Inc., a land surveying company based out of Albuquerque, New Mexico.

David's company specializes in construction surveying, boundary surveying, HD laser scanning, and UAV/drone mapping services. David is passionate about the future of land surveying in New Mexico and serves as the president of New Mexico Professional Surveyors.



KATE FAIRLIE

LAND ADMINISTRATION SPECIALIST AT LAND EQUITY INTERNATIONAL UK AND AUSTRALIA

KATE FAIRLIE HAS A BS IN ENGINEERING (surveying and spatial information systems) and ten years of experience spanning the surveying, mapping, and land administration/land governance fields. She currently works with Land Equity International, an international development consultancy specializing in land administration and policy.

Her recent projects include piloting low-cost land titling in urban Tanzania, developing a roadmap for national urban cadastral reform in Ethiopia, and reviewing the process of mutual recognition of surveying professional services in ASEAN countries. Prior, Kate was a consultant to UN-Habitat, researching youth access to land and decision-making spaces.

Kate is a past chair of the FIG Young Surveyors Network and current FIG Commission 1 Working Group chair. She is an ambassador with Business Events Sydney, and, alongside her day job, is undertaking a part-time MSc in sustainable urban development at the University of Oxford.



CARLA GIBSON BOISVERT

GEOMATICS SPECIALIST AT CANADA NORTH ENVIRONMENTAL SERVICES
SASKATCHEWAN, CANADA



CARLA GIBSON BOISVERT HAS MORE THAN SEVEN YEARS' EXPERIENCE as a geomatics specialist in the mining and exploration field, with a focus on Saskatchewan and its unique mapping challenges.

Peers have noted Carla's ability to rapidly overcome such challenges and master essential skills.

With a bachelors of geography in physical/technical geography (with honors) and an advanced GIS diploma from the British Columbia Institute of Technology, her expertise lies in analyzing data, solving

problems, and producing value-added maps. Knowledge of data produced from potash, uranium, and oil and gas mines has increased her expertise in mapping for engineers, biologists, and geologists.

Within the scope of engineering, biology, and hydrogeology, Carla has worked on tailings-management area planning as well as aquifer, surface water, and subsidence mapping. Mapping of rare plant and animal species as well as habitat classification were an integral aspect of her experience. In addition, she has specific training in ground-based lidar (using such software as Polyworks) for engineering projects such as tailings pile movement and potash tunnel subsidence.

MARC M. DELGADO

GEOGRAPHY PROFESSOR AT THE UNIVERSITY OF ASUNCION

PARAGUAY

A VISITING PROFESSOR in the Faculty of Engineering of the Nacional University of Asuncion, Paraguay, Marc M. Delgado teaches GIS applications in land use planning and urban studies, as well as geodatabase design. Marc completed his PhD (summa cum laude) and MS (magna cum laude) at the Vrije Universiteit Brussel in Belgium and his BS at the University of the Philippines. His research interests are in the applications of participatory geographic information systems (PGIS) in natural resource management, rural development, and health issues.

In 2006, the Belgian minister for development cooperation awarded Marc with the Development Cooperation Prize for his master's thesis on the role that accessibility to basic services has on poverty incidence in a tropical mountain area of the Philippines. For his PhD research, the U.S. Regional Chapter of the International Association for Landscape Ecology awarded him with the Foreign Scholar Travel Award in 2012.

While finishing his PhD, Marc

worked with Philippine-based NGOs on topics related to poverty and health. He was the GIS specialist for the Peace and Equity Foundation where he developed poverty maps in 28 Philippine provinces so that development projects can be targeted to fit the geographic limitations and conditions of poor areas.

His current research and teaching focus on the use of geospatial tools for visualizing and analyzing geographical data, mainly through the active participation of local users. He has done this using participatory landscape terrain modeling in natural resource planning; the promotion of open-source GIS such as QGIS, gvSIG, and MapWindow in GIS education; and using the mobile app KoboToolBox to enhance the usefulness of geography in teaching college. He also mentors a set of Paraguayan students to become the next generation of modern geographers in a country where GIS and other mapping technologies are still relatively new and not widely accessible.



INGRID NOYOLA DE LA LLAVE

SURVEYING AND
PHOTOGRAMMETRY ENGINEER

MEXICO

AS A STUDENT ENGINEER IN SURVEYING AND PHOTOGRAFOMETRY at the National Polytechnic Institute in Mexico, Ingrid Noyola de la Llave was student representative of the School Advisory Council of the College of Engineering and Architecture. In 2013 Ingrid and her two best friends created a company dedicated to advanced surveying and geodesy, ASGEO (Association of Specialists in Geomatics, Surveying and Geodesy). To improve its capabilities, Ingrid has begun graduate geomatics studies at Centro GEO, a public research center. She has also participated in projects conducted by the National Autonomous University of Mexico (UNAM).

The collective thesis Ingrid developed titled "Analysis and Comparison of Mexican Geoid Models," was exhibited at UNAM, and as a scholarship holder from Petróleos Mexicanos she led a project focused on resources for analysis of hydrogen sulfide, which resulted in successful implementation by a Canadian resource management firm.

Ingrid is committed to contribute to the geodetic knowledge of her country and is particularly interested in studying physical geodesy, a branch that includes gravity modeling; this she feels is not fully leveraged in Mexico. Her advice for young people entering geomatics careers: "Commitment and constant study will allow you to achieve whatever purpose you have in mind."



CHETHNA BEN

ASSISTANT LECTURER AT THE UNIVERSITY OF THE SOUTH PACIFIC,
SCHOOL OF LAND MANAGEMENT AND DEVELOPMENT FIJI

CHETHNA BEN, THE DYNAMIC YOUNG GEO-PRACTITIONER, likes to say, “Without definition of what and where something is, we cannot reach it.”

Chethna is described by peers and colleagues as ebullient; she loves God, her family, and the environment. She wants to transform the way we do things and to make the world around us truly spatial and sustainable. Her passion in geospatial science has been in investigating how cross-discipline work can incorporate the tools of GIS for modeling and analysis. Her specialist areas are research in sustainable development; spatial economic analysis; disaster preparedness

and community resilience; urban and regional management; and planning and development using geospatial science.

Chethna is a PhD candidate at the University of Melbourne; a member of the Young Surveyors Network; and part of the working group for Commission 2 of FIG (International Federation of Surveyors). She also participated in the Global Shapers World Economic Forum; International Academic Association on Planning, Law, and Property Rights; and the Pacific Rim Real Estate Society. She has more than four years of diverse industry experience working with academic, government, and civil society organizations.

ADAM D. CREWS

OWNER OF CREWS SURVEYING LLC

PENNSYLVANIA, USA

ADAM CREWS IS A SECOND-GENERATION SURVEYOR; his father worked as a land surveyor in several capacities beginning in the 1970s. Adam started work in surveying when he reached the minimum age he could work for a family member, and he fell in love with the profession.

Adam attended Penn State University in the Surveying Engineering Baccalaureate program. That's where he became aware of the importance of professional organizations and started his involvement with the Pennsylvania Society of Land Surveyors (PSPL), including joining the independent Penn State Surveying Industrial Advisory Committee.

A mere 14 years after graduating, Adam started his own surveying company, and in the same year (2013) he reached the peak of state-level professional involvement by becoming the president of PSPL.

Adam looks forward to the impact of UAS on the surveying profession strongly believes that surveyors should be not only accepting this new technology but also leading its implementation for mapping and measurement.



ALOK SRIVASTAVA

SENIOR PRODUCT MANAGER OF GNSS AT TOPCON

CALIFORNIA, USA

NOTING HIS BROAD EXPERTISE and ability to master so many subjects, Alok Srivastava's colleagues joke that, “this guy must be 100 years old.”

After completing his B.Tech (civil) at the Indian Institute of Technology in Bombay (Mumbai) in 2005, Alok moved to Ohio to earn his MS in GIS/mapping at Ohio State University—which has earned global recognition as a hub of geomatics sciences and is prime recruiting ground for manufacturers and developers.

Alok soon joined Topcon Positioning Systems as a software engineer in their GIS group. Rising steadily in the ranks of Topcon, he focused on GNSS product development as Topcon was entering a period of ambitious and, in many ways, groundbreaking development in this area.

Alok is known for being able to rapidly evaluate development ideas, identify practical challenges to potential roadblocks, and then successfully plow full-speed ahead. He has figured prominently in many of the most significant developments in Topcon GNSS and related products in recent years.





ADAM SCHLEICHER

**UTILITY ENGINEER AT THE WISCONSIN
DEPARTMENT OF TRANSPORTATION**

WISCONSIN, USA

WHEN PEOPLE THINK OF SURVEYING, they mainly think of property boundaries and the significant responsibilities in determining them: the financial and legal implications surveying practitioners bear on behalf of their clients. But this also holds true for other elements of surveying—consider the 3D world of utility engineering. A bright young leader in this field is Adam Schleicher, the driving force behind several initiatives promoting the surveying profession.

Adam has a BS in civil and environmental engineering from the University of Wisconsin-Madison. He has also taken surveying courses at the Madison Area Technical College and Northeastern Wisconsin Technical College. He has been active with the Boy Scouts as a surveying merit badge counselor and was selected to participate in the 5th International Training Course in Topography for Young Surveyors [YS] held in Lisbon, Portugal, in 2013. After the week-long program, the participants attended the 1st FIG YS European Meeting. Adam then helped lead the 1st FIG YS North American meeting in San Diego. He established the NSPS YS Facebook page and the first YS chapter of a state association in the U.S. (Wisconsin).

A quote from Adam summarizes the reason why multiple people nominated him: "Surveying is a unique and challenging field, and I could not imagine doing anything else. Every day is a new challenge, and there is always more evidence to research and data to collect. No two surveys or days have ever been the same. I feel the future of surveying is very bright. I am amazed by the technological advices that have occurred even during the short time I have been surveying and can't wait to see what the future will hold."

SANA KHUSHI

**GIS MANAGER IN THE URBAN UNIT PLANNING AND DEVELOPMENT
DEPARTMENT PAKISTAN**

THE POWER AND IMPACT OF GIS

and geomatics sciences on the planning, development, human geography, and management of a nation's built and natural environments are splendidly exemplified by the work and career achievements of Sana Khushi.

Sana earned her two masters (in GIS and geomatics) from the University of the Punjab in Lahore and is pursuing her PhD in geomatics there, as well. Her involvement and leadership in a variety of national initiatives using geospatial data are noteworthy achievements, but so is doing so in a non-traditional role. Sana is widely lauded for expertise, integrity, and tenacity.

As an example of her work, UNICEF used the Urban Unit's services to develop a geospatial-decision-support system to assess the school education fa-

cilities in Punjab Province on the district level; the federal government had asked the provinces to show how they spent their budget on development projects. To develop supporting data, Sana's tasks included supervision of GNSS and photographic survey teams, supervision of daily data collection and its management in ArcGIS, demarcation of schemas for high-resolution satellite imagery, reporting, and budgeting.

Sana also assisted in the development of the GIS-based elements of an automated wheat procurement system, a land records management information system, and various GIS decision-making themes that support such initiatives as neighborhood crime watches. She's also involved in a New City initiative that seeks to support urban revitalization and managed growth.





DIANA BEĆIREVIĆ

SURVEYING ENGINEER CROATIA

DIANA BEĆIREVIĆ IS A PROACTIVE ENGINEER, with a BS and an MS in geodesy and geoinformatics from the Faculty of Geodesy, Croatia. She also served as the editor-in-chief of a student magazine that encouraged cooperation between academia and the private sector, which is still active today. After school, at a surveying equipment distributor in Croatia, she worked as a research intern in laser scanning and UAV applications and as a surveyor performing scan-to-BIM projects. She is enthusiastic about real-time sharing and collaborating using aerial data.

Diana shines especially in her volunteer activities. She's a member of the executive board of the Council of European Geodetic Surveyors and a representative for FIG Young Surveyors in Europe. She has also earned honors and awards, including the Rector's award for a cloud-based GIS application for all elementary schools in Zagreb, and her team won first place in a student contest organized by the Council of European Geodetic Surveyors for her research and development plan for remediation of a landslide in Croatia.

EVEN ROUAULT

OPEN-SOURCE DEVELOPER,
GEO-BLOGGER, AND OWNER OF
SPATIALYS FRANCE



IF IT HASN'T ALREADY HAD AN IMPACT ON YOUR INDUSTRY OR PROFESSION, the open-source software movement likely will soon. For more than a decade in the geospatial realm, open-source software has proven to be a viable path; small firms, large corporations, cities, states, agencies, and even entire countries have instituted “consider open-source-first” policies. It’s not just about cost savings—but also excellent solutions.

The development environment for open-source software is that of global collaboration. Developers from all over the world can work code together through online collaborative sites such as GitHub, and this community of unsung heroes has its own leaders.

Shortly after the release of last year's “40 under 40,” the open-source geospatial software development community began “Twitter storms” for this year's selection; a prominent name was Even Rouault.

Even is a software developer who uses geospatial tools such as GDAL/OGR, developed as open source and governed by a project steering committee under the Open Source Geospatial Foundation (OSGeo). Even is currently the chair of that steering committee and has been a key developer and maintainer since 2007. His popular developer's blog about tips and tricks and GitHub resources—and his company Spatialys—are all about collaboration: sharing ideas, code, and solutions. Even precisely represents the spirit of the geo-open-source development community.

BOHAN WU

SUPPORT ENGINEER AT TRIMBLE

GERMANY



DO YOU EVER WONDER who support specialists at your dealers and manufacturers turn to when they're stumped? Support engineers like Bohan Wu are the vital life-line for them. People working in the product lines of Trimble infrastructure (reference networks and monitoring) sometimes characterize a technical conundrum as a “Bohan-level” question.

After her freshmen year at Wuhan University in China, Bohan was selected by the university to continue to pursue her BS in engineering, and later her MS in geodesy and geoinformation at the University Stuttgart in Germany. Bohan joined Trimble Germany directly after graduation, offering technical support and training globally for those customers who use network (RTN) and monitoring solutions.

To date, Bohan has supported many RTN administrators as they install, maintain, and upgrade their systems, carefully executing complex upgrades and installs while keeping the flow of data to the end users in the field without interruption. RTN operators say they owe Bohan a debt of gratitude for saving substantial time and costs—and avoiding a lot of heartburn.

SHAUN PIEPKORN

AREA SURVEY MANAGER AT GORRONDONA & ASSOCIATES

TEXAS, USA

SHAUN PIEPKORN IS A REGISTERED PROFESSIONAL LAND SURVEYOR in Texas and is the Dallas area survey manager for Gorrondon & Associates, Inc., where he manages operations that include land surveying, lidar, aerial photogrammetry, GIS, geotechnical engineering, and construction-materials testing. With a diverse background in land surveying and GIS, along with a company that stays ahead of the curve in technology, Shaun combines his company's services to best fit the client's needs, budgets, and schedules. For example, a recent large-scale transportation project involved the combination of traditional surveying methods for control, helicopter lidar for design-grade topographic mapping, mobile lidar and terrestrial scanning to map and model bridge structures, and aerial mapping to provide orthoimages of the project.

Shaun is an active member of the Texas Society of Professional Surveyors (TSPS).

He serves as the Dallas chapter president and was named the 2016 TSPS young land surveyor of the year. Shaun is also a member of the public relations committee. In 2015, the society was awarded first place nationally for their recruitment campaign submission to the NSPS.

At the state level of TSPS, Shaun is the SkillsUSA chair. SkillsUSA promotes career and technical education for high-school students throughout the U.S., and TSPS directs the land surveying competitions. Land surveying is one of the largest competitions, and many students who have completed the curriculum have received college scholarships, have passed the Level I Certified Surveying Technician exam, and have had no problems finding employment in the profession. Shaun volunteers to teach land surveying at three high schools in the Dallas area. For the past two years, his teams have swept first, second, and third places at the SkillsUSA state competition.



NIMAS HAYU MERLINA ANGGARINI

TECHNICAL SPECIALIST AT HEXAGON GEOSPATIAL

SINGAPORE

FOR HER BS THESIS

in geodetic engineering at Universitas Gadjah Mada in Indonesia, Nimas Hayu Merlina Anggarini researched the "Rate of Displacement and Strain Computation of Sumatran GPS Array (SuGAr) Station from 2011 to 2013." Such an auspicious start to her career was followed by a series of postings of increasing responsibility in the fields of



land surveying, geodesy, GNSS, and remote sensing and as a university assistant lecturer teaching about databases.

Large geospatial solutions providers such as Leica and Hexagon know that the stakes are high for their clients, and technical support requests need to be answered not only rapidly, but by bright and capable support specialists. Nimas was recruited by Leica Geosystems in

Jakarta, providing support for surveying equipment and geospatial software, then transferred to Leica's sister company Hexagon Geospatial, providing technical assistance in support of business development activities in services' project work in the ASEAN (Association of Southeast Asian Nations) region. The future looks particularly bright for Nimas and for other talented young professionals who bring a solid foundation in geomatics education to the new dynamics of our increasingly geospatially-enabled world.



BIPLOV BHANDARI

**RESEARCH ASSOCIATE AT THE GEOINFORMATICS CENTER
IN THE SCHOOL OF ENGINEERING AND TECHNOLOGY, ASIAN
INSTITUTE OF TECHNOLOGY THAILAND**

**MEMBER AND SOFTWARE DEVELOPER FOR SAHANA
SOFTWARE FOUNDATION CALIFORNIA, USA**

BIPLOV BHANDARI EARNED HIS BS IN GEOMATICS ENGINEERING from Kathmandu University, Nepal, in 2014, and now he applies GIS to humanitarian efforts. As soon as he graduated, he worked as an independent consultant for Development Gateway, a nonprofit delivering technology and information solutions for international development, then as a geomatics engineer for Kathmandu Living Labs in Nepal. His specialty is OpenStreetMap and web development.

In Thailand, he works as a research associate for CAP-on-a-MAP, an application for location-specific early warnings, and as a software developer at Sahana Software Foundation, where he's developing Common Alerting Protocol that enables an early warning system for The Philippines, The Maldives, and Myanmar. He is also working with the open-source project, Sahana Eden (Emergency Development Environment), an open-source framework to rapidly build powerful applications for emergency management.

NARELLE UNDERWOOD

SURVEYOR GENERAL OF NEW SOUTH WALES

AUSTRALIA

THERE HAVE BEEN 25 SURVEYOR GENERALS OF NEW SOUTH WALES

([NSW] the most populous state of Australia) since 1787. The 25th is Narelle Underwood. Narelle has had an eventful decade in surveying in both the private and public sectors. After serving for six years as a candidate surveyor with a private firm, Narelle joined the NSW Roads and Maritime Services as a graduate surveyor and earned the professional status of registered land surveyor. Narelle has since earned postings of increasing responsibility in both surveying and spatial data capture and management. Her appointment as the first female surveyor general of NSW, a posting that falls under the NSW Department of Finance, Services and Innovation, was effective October 2016.

Narelle has been a tireless supporter of the surveying profession, especially in promotion and outreach among young surveyors. Her list of awards includes being the Asia Pacific Spatial Excellence Awards Young Professional of the Year, the NSW Surveyor General's International Fellowship and NSW Young Professional of the Year, and numerous academic honors and civil/surveying competition prizes. Narelle earned her BS in engineering, surveying & spatial information systems from the University of NSW.



HAYDEN HOWARD

VICE PRESIDENT AT COMPASSDATA, INC.

COLORADO, USA

HAYDEN HOWARD BEGAN WORKING IN THE FAMILY-OWNED BUSINESS of CompassData when he was 15, helping survey ground control with his father and other staff. A graduate of Metropolitan State University, Denver, in land planning (GIS) and aviation, he now directs all aspect of CompassData, including operations, technology development, sales, and marketing.

Hayden has worked to develop and mentor CompassData "Control Freaks": world-travelling students, ski patrol, mountain climbers, EMTs, and ex-military trained to collect data with GPS survey equipment.



Under Hayden's leadership in 2015, CompassData received its D0200A certification from the FAA to produce authoritative ground control and imagery over airports. This data is used to build Aerodrome Mapping Data Base (AMBD) products approved to use in avionic systems.

ERIKA WOOLSEY

CEO AND CO-FOUNDER OF THE HYDROUS

CALIFORNIA, USA

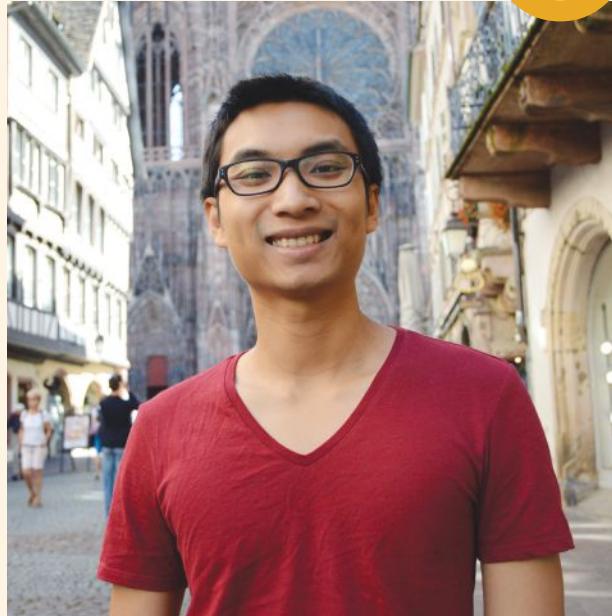
AS ERIKA WOOLSEY PROGRESSED through her academic and scientific career, she felt something was missing. She said, “[My] message was reaching a limited group of people who already understood the problems.” What was needed to protect and preserve critical ocean habitats was a broader inclusion of stakeholders, and thus she co-founded The Hydrous, a nonprofit education and outreach company.

The Hydrous provides open access to the wonders of the world’s oceans via expeditions, marine surveying, scanning, hydrography and bathymetry, virtual reality, 3D models, and 3D printing, all to highlight the effects climate change and humans are having on our oceans—and particularly on reefs and near-shore habitats. As she notes, “How can we protect what we can’t see?”

Woolsey studied biology at Duke University, then coral reef ecology and biological oceanography at the Bermuda Institute of Ocean Science. She earned her MAs at the University of Sydney, then her PhD with the ARC Centre of Excellence for Coral Reef Studies at James Cook University in Townsville, Australia. Woolsey is broadly published and worked in many research positions before co-founding The Hydrous.



40 FORTY
UNDER



MELISSA ROBERT SARRAUTE

SURVEYING ENGINEER AT THE URUGUAYAN MINISTRY OF
TRANSPORT AND PUBLIC WORKS URUGUAY

AS ONE OF EIGHT YOUNG SURVEYORS (FROM MORE THAN 1,200 GLOBAL APPLICANTS), Melissa Robert Sarraute was selected to attend and participate in the 2014 XXV Federation of Surveyors (FIG) International Congress in Kuala Lumpur, Malaysia, representing South America.

A natural leader and skilled public speaker, Melissa has organized, participated in, and presented at meetings and conferences of surveyors (especially young surveyors) and surveying students in South America, including Argentina, Brazil, Colombia, and Uruguay. Melissa also made a presentation at the 2nd International FIG Young Surveyors Network (YSN) in North America, reporting on her activities in South America.

Melissa graduated from the Faculty of Engineering of the University of the Republic in Montevideo, Uruguay, with a degree in surveying engineering. From 2010 to 2012, she worked as an intern for the municipality of Montevideo in the Land Registry and Valuation Sector. Next she worked at the National Cadastre in the Collation and Registration Section. She currently works for the Uruguayan Ministry of Transport and Public Works Surveying Section as part of the “Geoportal MTOP” project in the discipline of GIS.

Melissa has been designated by the FIG Foundation as a foundation ambassador to promote FIG and the surveying profession in Latin America.



ARNADI DHESTARATRI MURTIYOSO

RESEARCHER AT ICUBE LABORATORY,
UNIVERSITY OF STRASBOURG FRANCE

THE DIGITAL 3D IMAGING AND PHOTGRAMMETRY REVOLUTION, enabled by UAS and its software boom, has expanded opportunities for talented young researchers in academia and commercial laboratories. The fruits of their research rapidly make it into your geomatics toolkits.

Since his bachelor studies, Arnadi Dhestaratri Murtyoso has been focusing on research into the use of geodetic and topographic techniques for the documentation and conservation of cultural heritage sites, using mainly photogrammetry and laser scanning. After a stint as a research assistant in the remote sensing and GIS research group of the Bandung Institute of Technology (in his home country of Indonesia), Arnadi worked with leading geomatics research laboratories in Europe, including the 3D Optical Metrology of the FBK Trento (Italy), the Institute for Photogrammetry of the University of Stuttgart, and his current lab posting: the photogrammetry and geomatics group of the ICube Laboratory in Strasbourg.

Arnadi is a member of the CIPA heritage documentation group (a joint organization of the International Society for Photogrammetry and Remote Sensing) and the International Council on Monuments and Sites. His current research is in the development of UAS-based methods for the modeling and high-precision, close-range inspection of heritage buildings; this includes co-authorship of the publication, “Oblique Aerial Photography Tools for Building Inspection and Damage Assessment.” Arnadi plans to continue doctoral studies at the University of Strasbourg.



MICHAEL WYATT

SURVEYING AND PROJECT MAPPING COORDINATOR AT J.F. BRENNAN CO. INC.

MICHIGAN, USA

MANY SURVEYORS ENJOY MASTERING MULTIPLE DISCIPLINES within the surveying profession. For Michael John Wyatt, his disciplines include hydrographic survey and inspection, land survey, and heavy equipment navigation systems. His approach comes in part from being with a prominent multi-discipline firm in the region, JF Brennan, with diverse services that have had John working projects all over the country.

John received a BS in surveying engineering from Michigan Tech in Houghton, MI. He has been with Brennan for just over eight years, and in that time Brennan

has grown significantly and has continued to promote new technology and innovation. John says, "I oversee and work with a talented group of professionals who are all dedicated to bringing innovative, efficient, and accurate survey methods to our clients. It amazes me how fast the younger surveyors pick up on and excel with our survey systems. I feel like what took me years to figure out takes them weeks." His current work interests involve developing a user-friendly interactive 3D product for clients, multibeam sonar as a structural inspection tool, and modeling submerged vertical surfaces.

JASNA FILIPOVIC

PROJECT MANAGER OF THE WATER AND WASTEWATER SYSTEMS IN THE HALTON REGION

ONTARIO, CANADA

WE ASKED LAST YEAR'S "40 UNDER

40" honoree Caitlin Blundell if she knew of a rising star in the Canadian geomatics community, someone having an impact at the local level and serving as an inspiration for other young folks entering the geospatial professions. Her rapid answer was Jasna Filipovic. Others in the Canadian geomatics community concurred.

Jasna is an enthusiastic geospatial practitioner—enthusiasm that peers say is contagious. A GISP with a degree in environmental studies (honors in geography) from the University of Waterloo, Jasna was a student GIS analyst for the City of Toronto, working on transportation projects. She then worked for the provincial elections authority.

After joining the Halton Region as a GIS coordinator in the business and technical resources group, Jasna took a project manager position three years ago. In addition to her demanding day job, Jasna has continued to volunteer, using her GIS skills to aid green initiatives, and she is the director and VP of the Urban and Regional Information Systems Association (URISA) of Ontario.



JONATHAN DOWNEY

FOUNDER AND CEO OF AIRWARE

CALIFORNIA, USA

AN UP-AND-COMING YOUNG GEOSPATIAL PROFESSIONAL,

Jonathan Downey is also prominent in the UAS industry both nationally and internationally. A graduate in electrical engineering and computer science from MIT, Jonathan has served as a commercial pilot, has developed components for motorcycles, and was a software engineer at Boeing, contributing to the development and flight testing of the A160T Hummingbird, a three-ton fully-autonomous helicopter that broke the world record for longest-endurance helicopter flight.

A passion for robotics and aviation lead Jonathan to UAS, and he's been developing them for more than a decade. He founded Airware in 2011 to eliminate the barriers preventing businesses from taking full advantage of drone technology. He has since led Airware to raise over \$70 million in venture capital from top investors in Silicon Valley. Jonathan is the general partner for Airware's Commercial Drone Fund (launched to accelerate innovation in the commercial drone space) and is a member of the board of directors for the Association for Unmanned Vehicle Systems International.



LAURA VAN DE VYVERE

PROJECT ENGINEER AT M3 SYSTEMS

BELGIUM

MANY OF THE SOLUTIONS employed in geomatics sciences are no longer limited to purely spatial measurements. Remote sensing, lidar, InSAR, and even GNSS can now yield far richer data on the physical properties of the objects and mediums that their signals contact and pass through. The related work of this young geomatics professional has gained international attention.

Laura Van de Vyvere received an MSc in geomatics and geometrolgy from the University of Liège, Belgium. Her master's thesis was dedicated to Galileo cycle slip detection under extreme ionospheric activity. In 2015, she joined M3 Systems Belgium as project engineer in radio-navigation and is involved in GNSS reflectometry and GNSS hybridization projects.

The objective of the MISTRALE project (Monitoring soil moisture and water-flooded areas for agriculture and environment) is to provide RPAS/UAS-based soil moisture maps. To do so, it relies on an innovative use of the GNSS signals: reflectometry (GNSS-R). This approach consists of comparing the direct signal with those reflected by the ground. In the context of the MISTRALE project, both GPS and GALILEO signals will be used, which will improve system performance.

In July 2015, two experimental flights were conducted in France with the aim of validating the technical feasibility of the project concept. The analysis of the data collected has shown promising results: high-reflectivity values were observed for rivers, basins, or irrigation canals, whereas the low-reflectivity values were associated with dryer areas or with a higher presence of vegetation. We will continue to follow Laura's project as it progresses.



40 FORTY
UNDER

HEIDI JACKSON

SURVEY TECHNICIAN AT NORTHSTAR LAND SURVEYING OREGON, USA



LIKE MANY SURVEYORS, Heidi Jackson took a scenic route to the profession. Growing up on a family farm in Wisconsin, she developed a love of the outdoors. While earning a BA in geography, she sought as her final project to map ideal locations to move to after graduation. Bellingham, WA was near the top of the list, and she spent several years there working on the board of the nonprofit organization, Wild Whatcom, that creates outdoor experiential learning opportunities for children and families.

Enrolling at Bellingham Technical College and taking an internship with the Department of Natural Resources exposed Heidi to the wonders of the Pacific Cascades and tales from her instructor and other seasoned surveyors about surveying adventures. When *xyHt* contacted Heidi to write about what inspires her as a young surveyor, she replied, "I want to be Indiana Jones with a tripod." (Her essay is online at: goo.gl/G0gRAC)

Heidi is interested in exploring the broad range of opportunities within land surveying and getting experiences from backwoods boundary surveying to big city construction to hydrographic surveying—she would like to try it all. She is also passionate about helping to promote surveying to the next generation, is on the board of the NSPS Young Surveyors Network, was a volunteer tutor for other surveying students, maintains a surveying society website, and is their youth page editor.

SOLOMON NJOROGE NJOGU

GRADUATE STUDENT AT TECHNICAL UNIVERSITY OF MUNICH GERMANY

SOLOMON NJOROGE NJOGU, a Kenyan national, is a dedicated surveyor and a software developer in land administration. He is pursuing his MS in land management and land tenure at the Technical University of Munich, Germany. Solomon completed a BSc in geomatics engineering and GIS from Jomo Kenyatta University of Agriculture and Technology in Kenya; he also undertook postgraduate training in programming and mobile-application development with Nokia East Africa.

At the UN Habitat Through Global Land Tool Network in Nairobi, Solomon contributed to new thinking in land administration and the paradigm shift in land-tools development, specifically for the Social Tenure Domain Model (STDM) and its implementation in several countries. He interacted with and built capacity for

hundreds of young surveyors globally and other experts in land administration, contributing to a new vision for surveyors as managers and decision-makers beyond being technical experts.

Solomon says, "It's a daunting task to be a change agent in a system too rigid to change, but strong will and determination (beyond personal gain) for a greater good is what keeps me going. It's very difficult to be a modern surveyor in my country where the system is quite conservative and impenetrable. However, I am a strong advocate for technology, especially along the current trends of fit-for-purpose approaches in land administration." Solomon is researching technological and legal opportunities for implementing new, bottom-up approaches in land management as an alternative to current complex, mainstream systems in Kenya.



RAFFAELE ALBANO

RESEARCH ASSOCIATE, UNIVERSITÀ DEGLI STUDI
DELLA BASILICATA ITALY

WATER, LANDSCAPE, AND NATURE have played an important role in Raffaele Albano's work as an engineer. He works to analyze their interaction—and human-impacted challenges—from a geospatial point of view, but also as a citizen who wants to be aware of his home. He is the co-founder of the Wat-TUBE spin-off, a start-up company devoted to the technology transfer of research results in geomatics and water resource management. He serves as young scientist representative of the Natural Hazard (NH) Division in the European Geosciences Union, providing an opportunity to re-think the role of early career scientists from consumers to contributors to the NH community. Raffaele has a great love for history and geo-heritages and cultivates this passion as a volunteer in the UNESCO Young Italian Commission.

Raffaele's research and professional activities revolve around developing models and modeling applications, mainly published as open-source software, to support flood- and drought-risk management. He has developed plug-ins for QGIS (FloodRisk for flood damage estimations and GeomorphicFloodIndex for the delineation of flood-prone areas through a DEM-based approach), a software to help farmers improve agricultural water management called MYSIRR, and a webGIS application called READY to increase people's awareness in landslide- and flood-risk prone areas. Raffaele also teaches abroad, at the undergraduate and post-graduate levels.



FRANK FERRANTELO

PRESIDENT OF FERRANTELO PROFESSIONAL SURVEYORS AND LAND PLANNERS NEW YORK, USA

EXECUTING LAND AND CIVIL DESIGN in and around one of the world's largest metropolises is not for the faint-hearted. Dizzying skyscrapers, massive public works, rapidly expanding high-end residential complexes, intensely complex survey records, and regulatory and permitting processes: these are in the wheelhouse of Frank S. Ferrantello.

As a professional land- and civil-design consultant with his hands on unique, individualized approaches, Frank is a land surveyor and land planner who has designed, presented, and gotten approval for many site plans, subdivisions, and condominium plans. He has also surveyed high-rise buildings throughout New York City and has performed air rights surveys, builder pavement plans, architectural topographical surveys, and building monitoring plans and studies.



Frank seeks to move the profession forward by example, implementing state-of-the-art technology and presenting to planning commissions and zoning boards. Frank says, "The profession itself is to define the property lines and measure the evidence we find." He has a diligent approach to find all manner of evidence to come to a definitive point, often, as peers note, way beyond the reasonable doubt that others might have.

BRANDY GREER

PRODUCT MANAGER, NETWORK SERVICES AT
TOPCON POSITIONING SYSTEMS, INC. FLORIDA, USA

BRANDY GREER graduated from Texas A&M University - Corpus Christi with a BS in geographic information science. Her field career began when she was a student working at a local survey firm where she was surrounded by intelligent people, confident in the principles of surveying fundamentals. Yet, she noticed that surveying skills did not always translate into being proficient with new technology.

With a charter to help with this integration, Brandy began working with a large distributor, acting as a support/training professional. She

then performed the same services on a national stage with Topcon. Working with a larger audience and more powerful tools, she started in a support role with a product support group, which took her all around the globe.

Now in the product management team at Topcon, Brandy works side by side with the engineers who are developing tomorrow's technology. She provides input on customer needs and participates in developing the many successful products you see in the field. Her recent work has been with Topcon's TopNET live network services.



MAMATA KUMARI AKELLA

SENIOR CARTOGRAPHER AT CARTO

COLORADO, USA

CARTOGRAPHY HAS BEEN CHARACTERIZED AS AN ART. Now, with access to richer datasets and the wizardry of modern cartographic tools—in skilled hands and in careful orchestration of form and function—maps have become art. *xyHt* is honored to have featured the maps-as-art work of Mamata Kumari Akella; more of her work is at goo.gl/8c9V4p.

Mamata has been a professional web cartographer since 2008. She earned her MS in geography from Penn State University and her BA



in geography from UC Santa Barbara. She started her career in web cartography at Esri, where she built online basemaps. At the National Park Service she pushed online, multi-scale map design using all open-source tools. She has worked with a variety of tools in the ever-changing landscape of digital mapping and has a passion for pushing the limits of cartographic design with current web technologies to build beautiful, well-planned maps. At

CARTO, Mamata is helping define the future of thematic web mapping where she hopes to make the process of cartographic design easier and more accessible to all.

RUI WU

TECHNICAL SALES ENGINEER AT TRIMBLE

COLORADO, USA

ONE CHALLENGE that comes with developing and marketing new, advanced technological solutions is to get not only the customers up to speed but also sales and support personnel. This is where the role of a technical sales engineer is essential, being able to parachute a highly skilled engineer into a situation and ensure everything will work for the customer. Trimble recruits promising engineers from all over the world and puts them through a rotation, working in various groups and with different product lines. At the end of his or her rotation period, each participant presents to peers and management. The otherwise-reserved Rui Wu is said to have hit hers out of the park.

Rui studied GIS and remote sensing at Peking University in China. She continued her education at Ohio State University where she earned her second MS degree. During her studies in Ohio, she worked as a research assistant on NASA's Mars project, processing many photos from NASA's Curiosity rover.

Rui joined Trimble Navigation in 2012. She values making sure customers understand fully the technologies they're using. Often she gets to "study" with the latest product before it's introduced to the market; then she shares her experience with her colleagues and company partners to help them become experts. They know that Rui is their go-to person when they're unsure about a product.



40
FORTY
UNDER



TODD FOSTER

MANAGING DIRECTOR AT MILESTONE SURVEY

AUSTRALIA

IN THIS YEAR'S ISSUE we had been looking for individuals or firms successful in taking advantage of modernization and maintaining high standards and best practices—boosting efficiency without compromising fundamentals. Milestone Survey and its managing director Todd Foster fit the bill. In addition to offering traditional surveying services, Milestone specializes in site and control establishment, integrity monitoring, and support for construction, mining, and utilities.

To be fair, accolades also belong to Deborah Foster who brought her own skills in innovation and high-tech-solutions' adoption to the firm while rapidly learning about geomatics. This geo-power-couple operates the firm's activities from both sides of the Pacific, managing operations and data with numerous cloud-based solutions. These include Asana, iAuditor, Evernote, Chrome Remote Desktop, Bluebeam Revu, smartpens, Time-Tracker, and Dragon Dictation. The excitement is not about gee-whiz apps and tools—each of these has yielded measurable efficiencies.

Todd's innovation was preceded by fundamentals. He attended pre-tertiary courses at Marist Regional College to prepare to enter the University of Tasmania where he earned his Bachelor of Geomatics in Surveying Technology. After serving two years as a graduate surveyor in a private surveying consultancy firm, Todd worked with firms supporting major dam projects. In 2011 Todd established Milestone Survey, which is expanding services throughout Australian and into the U.S.

HONORABLE MENTIONS

Of the highly regarded nominations we received, here are 20 additional young people worth noting who are leading the geospatial professions.

ADISORN PHANDHU-HONGS
Geomatics Engineer at C&C Technologies, Thailand

ALEX LOPEZ CRUCES
Geospatial Systems Developer at TRE Altamira, Spain

ANELIS Y. ACOSTA
Survey Specialist at Kinder Morgan, Texas, USA

DR. ARIEL BLANCO
Chairman of the Department of Geodetic Engineering at University of the Philippines, Philippines

CHUKWUMA JOHN OKOLIE
Freelance Geomatics Specialist, Nigeria



CLEÓPATRA MAGALHÃES PEREIRA
Geomatics Engineer at Engenheira Geográfica, Portugal

FRANKA GRUBIŠIĆ
Surveying Student at University of Zagreb, Croatia

GIJS VAN DER VELDEN
Co-founder and CMO at MXZ3D, Netherlands

GOWTHAMI DEEKONDA
Quantity Surveyor at Team ONE, India

JASON GRAF
Vice President at Gayron De Bruin, New York, USA

JENNIFER DAY
Lecturer at University of Melbourne, Australia



MARKO MESARIĆ
Project Manager at Modri Planet d.o.o., Slovenia

MATT WARNER
PLS, Survey Regional Service Group Manager at Herbert, Rowland & Grubic, Pennsylvania, USA

MOHINI TODKARI
Product Engineer at Esri, California, USA

PAU PRATS IRAOLA
Remote Sensing and Electrical Engineer at German Aerospace Center (DLR), Germany



RANDA NATRAŠ
Geodesy Engineer in Cadastre at Municipality Travnik, Bosnia and Herzegovina

ROBBIE STOKES
Engineering Surveyor at Zenith Surveying, UK

SANJAYA MANDAHAR
Survey Officer at the Survey Department, Government of Nepal, Nepal

SHAYNE AYFORD
Director at Optron, South Africa

WENDY WATSON
Director of Reference Station Operations at Leica Geosystems, Inc, Georgia, USA



BOOM BEHIND/ BOOM AHEAD

The outlook for surveying and geospatial services may soon swing up significantly, and being prepared may depend on paying attention to simple demographics. Generational shifts will dictate the types and magnitude of needed services and our ability to attract new practitioners to surveying and geospatial professions.

Of course, the future is impossible to completely predict, but certain factors that drive markets and services are inevitable and therefore should not be overlooked. Chief among these drivers is the immutable fact that people age, and they continue to age. We know when people were born, how many were born in any given year, when they will enter key periods in their lives, and when they will seek certain types of goods and services.

In the space of the past seven decades, the U.S. and many parts of the world have experienced three tremendous swings in births, with demo-

graphic repercussions reflected in the professions and industries of construction, engineering, surveying, mapping, utilities, and infrastructure. While other factors have influenced these markets, such as social and

geopolitical trends, characterizations of their impact can be subjective. Let's avoid those cans of worms (please!) and examine the population angle alone.

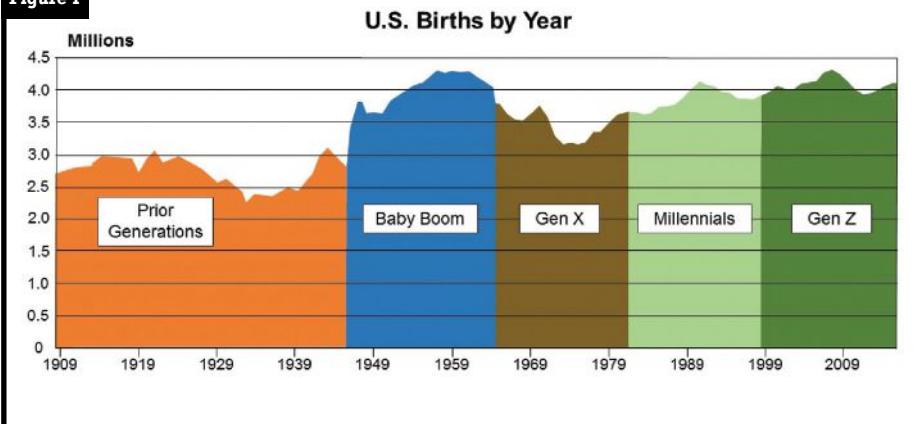
Sometimes the simplest and most obvious data is the

most telling. Imagine a surveyor called into a dispute between two property owners. Both are completely sure of their positions, but it takes the surveyor to research and measure. This involves hard data, which is the best place to start.

PEAK - TROUGH - RISE

The Baby Boom (generally characterized as the period between 1945 to 1960) saw a near-unprecedented rise in live births (Figure 1). That,

Figure 1



with immigration, contributed to almost doubling the population of the U.S. from the mid-20th century to today (Figure 2).

What followed, from roughly 1960 to 1981, has been dubbed Generation X, with a drop in total births: about 10 million fewer than the Baby Boom. People born between 1981 to 1999 are sometimes labeled as Generation Y or Millennials, and this group is already set to outpace the Baby Boom in the workforce (Figure 3). Indicators are that the group born since, sometimes called Generation Z, may sustain the upward trend.

Birthrate peaks and valleys echo throughout the respective lifespans of these groups. As time progresses, people reach certain age ranges that represent periods of their lives when they will, with some predictability, be in the position to seek specific types of goods and services. There are peak-earning years, nesting and family-starting years, then home-purchasing, empty-nest, downsizing, and retirement-housing years.

When age cohorts reach certain points in their lives—especially if many people enter or exit these periods in great numbers—there can be significant impacts on planning

and development and strains on utility and transportation infrastructure. When cohort numbers drop, shortfalls in disposable income, revenue, and investment can devastate markets and the ability to sustain infrastructure.

LEVITTOWN AND LAIKA

The coming boom may not be as pronounced for our professions and supporting industries as was the Baby Boom because of special events from the last half of the 20th century. The undercurrent of the boom was the near-doubling of the population, which drove an expansion of infrastructure the likes of which the world had never seen. For example, the U.S. interstate highway system is widely viewed as humankind's single largest public work. Together with the infrastructure created to support the Cold War and related space race, bases, and supporting industries, these massive expansions drove an unprecedented need for surveyors, civil engineers, mappers, and geodesists.

Events like the space race and its associated tech boom also, ironically, contributed to contractions in our professions. The launch of Sputnik in 1957, as GPS pioneer Charlie Trimble noted in our

November 2016 interview, "turned the education system in this country upside down." By the time Laika orbited the Earth only a month later, the U.S. and much of the world was furiously planning to upgrade science education, higher academia, scientific research, and other space/defense-related industries.

The era eventually produced GPS, satellite-based imaging, lidar, InSAR, scanning, and more. Our modern surveying instrumentation leapt from legacy analog roots to dizzying heights of digital wizardry in a few short decades. This wave of automation presents serious challenges to the profession, which I will touch on below.

The "big one" was the post-war suburban-sprawl boom, epitomized by the planned community of Levittown, New York, and numerous "Levittowns" spreading across the country. This boom was consistently sustained from the late 1940s until the early '80s, with a smaller echo in the early 2000s. As a result, many of today's surveyors (myself included) entered the field to fill the needs of the simultaneous housing, defense, and infrastructure booms. Since then, the sur-

veying profession has become noticeably older and has not fed the pipeline with new practitioners.

THE TROUGH

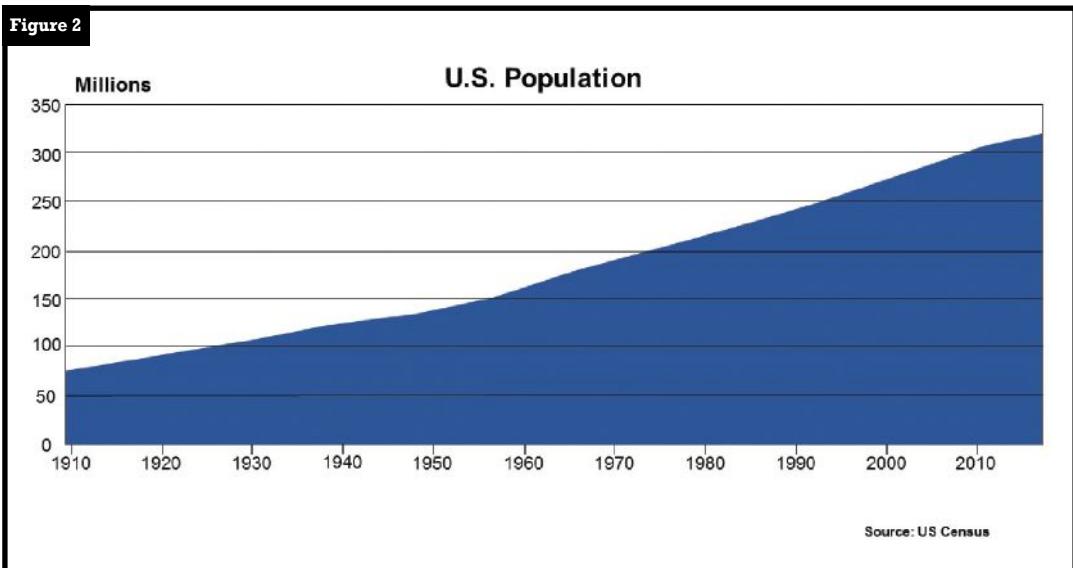
The 10-million drop in the number of live births during the Gen X trough might look like a relatively small drop compared to a total population around the 300 million mark. But a drop of 10 million spread across key age cohorts could (and arguably did) have the most direct impact on housing and development, markets for geo-services, related education programs, and sustaining infrastructure.

An interesting take on such impacts (and a good read) is *The Age Curve*, by Kenneth W. Gronbach. Gronbach examines the effects of the Gen X trough on markets for specific goods and services, ranging from import motorcycles to soda-pop, from jeans to housing. Most forward-thinking industries have recognized the power of demographics in future-casting; indeed, Gronbach was an invited speaker at Autodesk University 2015.

MILLENNIALS

Throughout history it seems that each succeeding generation feels that those who follow are not to be taken seriously (The "Four Yorkshiremen" Monty Python skit is a funny example). One thing is certain about this upcoming dynamic, though: the sheer numbers in key age cohorts of Millennials need to be taken seriously. We must watch when Millennials need key goods and services and how we can provide them—or Millennials will find other ways to get them. If our professions and related industries are not prepared, Millennials will find ways to do it themselves, make it themselves, or seek what they need

Figure 2





from firms in countries that have had the foresight to gear up for the coming wave.

Special characteristics of this millennial wave could temper the impacts in some areas yet accentuate them in others. This wave is diverse in education, worldview, life experiences, symbiosis with technology, mobility, urbanization trends, desires for green solutions, and more. (Whether previous generations view these characteristics as positive or negative is moot as the Millennials will chart their own path.) This wave can be good for business and good for succession planning for surveying and other professions as long as we recognize and consider those characteristics.

I hope that the use of the following word—diversity—is not read negatively. If the outreach efforts of our professions and industries do not make an effort to find a better fit with key characteristics of the millennial wave—all of it—we may find it much more difficult to meet the needs of this wave, to attract young people to the professions, and to stave off their seeking goods and services elsewhere.

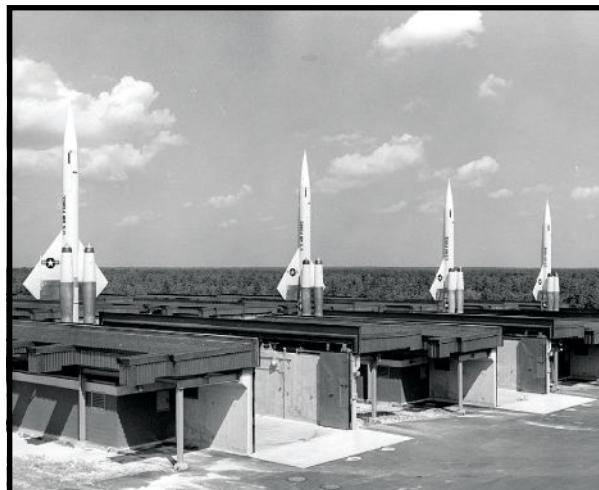
SMALLER WAVES

The automation wave has contributed to a reduction in the need for people doing certain tasks: a downside to increased productivity in

many cases. The manufacturing sector has most definitely wrestled with this, and to its credit, serious economic studies it commissioned have informed substantive and effective initiatives to provide steady supplies of the more-skilled workforce needed.

The current uptick in construction has been tempered by automation advances and construction globalization, with increasing opportunities for surveyors and engineers. The rub is that employers are often seeking new skill sets. Unfortunately, current education and training resources, having shrunk during the trough, are scrambling to fill the demand for these new skills.

While walking around



Since the 1950s, the population rise plus three factors increased the need for surveyors: public works such as the interstate highway system (above left), suburban sprawl (above), and cold-war infrastructure development (left).

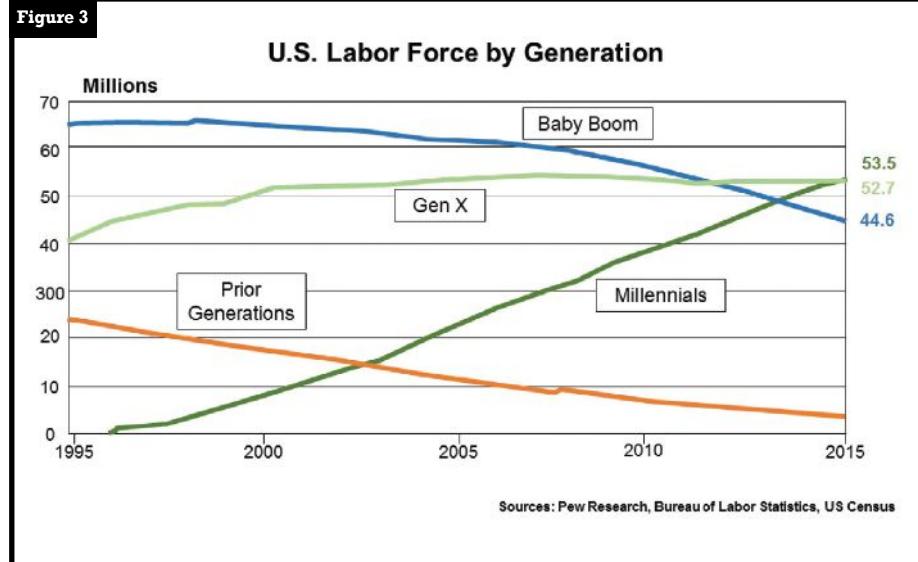


Future infrastructure, housing, and development needs will come with increased automation, urbanization, non-residential construction, and new skill sets needed. At left is the Lakhta Center under construction in St. Petersburg, Russia featured in the January 2017 issue of xyHt.

trade conferences, I'm amazed by the numbers of employers, large and small, who say they are desperately seeking good candidates who can hit the ground running. This is not just about technology as much as it is about experience in non-legacy types of work.. Urbanization trends result in less of the suburban-sprawl type work (e.g. plat staking and boundary) but more of the multi-unit and re-development type of construction projects—presently a mini-boom (Figure 4). The way such projects are approached requires different skillsets.

Consider BIM, for example. Sites with existing structures are now scanned, designed in 3D, and constructed using BIM. The new generation of clients grew up in a 3D world and (whether we like it or not) expect scans, UAS, 3D models, immersive representations, and more to be employed. A 2D drawing, in some ways, is as anachronistic to them as daily transportation via horse and buggy was to us.

Efficiency and automation have resulted in smaller crews and pose a serious challenge to us being able to provide direct mentorship and on-the-job training. This is where our professions and industries will need to get creative. Other parts of the world have successfully met these



challenges with formal (and incentivized) apprenticeships and vocation programs. We can learn from these.

PREPARATION

This is a new, different kind of demographic wave. It's perhaps smaller than the previous big wave, but we'll need to learn to surf it, and not with the legacy "long boards" we learned to ride decades ago. Here's what we might need:

New leadership. It should not be considered "ageist" for us to seek more representation from the new wave in high leadership positions in professional associations and societies. Having at least some new leaders from the new wave is critical: those who can under-

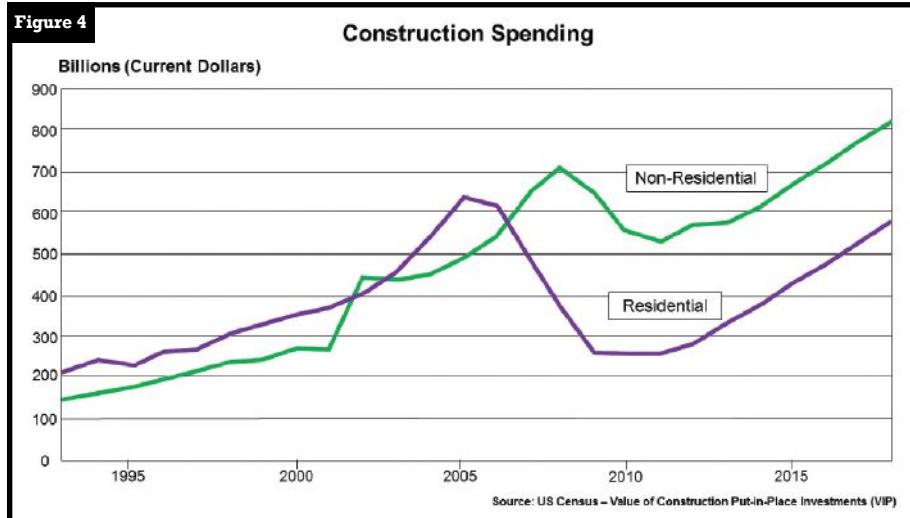
stand—and especially relate to—this and the upcoming generations. An example of progress in this direction has been the rapid growth of the Young Surveyors (YSN) groups, both internationally by the International Federation of Surveyors (FIG) and in the U.S. by the National Society of Professional Surveyors (NSPS).

Brand and messaging. Although our message might be less about "re-branding" and more "re-minding" the new wave who we are and what crucial services we provide, we may need to make more of an effort to remind in a manner that they can relate to. I am not talking about trying to explain geodesy through a rap song, but we could

start with not condescending to this new demographic.

Serious research. Here I've provided only a cursory look at demographics and market trends. Our professions and industries could follow the lead of other sectors that have commissioned serious economic studies, such as manufacturing, automotive, high tech, and more; often federal funds are available for workforce and market research. Related entities such as the NSPS have ongoing workforce-planning initiatives, and the Forum of the Future of Surveying is hard at work. Their success will depend on our willingness to participate and support them, but more critical is the willingness to step out of our comfort zones and acknowledge that there is something significant brewing on the horizon.

Looking at the graphs, we might conclude that the coming wave is a mere blip on the horizon or that other factors might make the wave moot. But can we afford to entirely ignore the signs? Especially with Gen Z following the Millennials, most likely sustaining the growth trendlines? Are we ready, and are we willing to get ready? ■



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We particularly enjoy introducing you to some of the top young talent in the geospatial world each year in our "40 under 40" section of Outlook, but we also know that many other visionaries have put their geospatial companies on the map, driving innovation and ideas for many years.

We've asked several of these to share their visions, telling us where they see this profession headed over the next decade or so. We appreciate the fact that these active professionals are out there representing the geospatial world and making sure their companies stay at the forefront of excellence.

Their visions and outlooks are on the pages that follow.

Tremendous Opportunity

Growth... is not a word commonly used by the average surveyor in today's market.. The business of surveying has changed along with the technology. This shift in the role of the traditional surveyor will change even faster in 2017.

More than ever, surveyors have opportunities in growth markets like energy, oil, gas, wind, solar, automated construction, and Building Information Modeling (BIM). These industries need the experience and expertise of a professional as new technologies are brought to market. The points and measurements you collect are no longer confined. They are instantly available, usable, and universally required. Professionally managed data will provide a continuous, repetitive process not limited by time or space.

GeoShack embraces these changes! Unlike other companies who have remained the same over the last 5 - 10 years,

GeoShack continues to lead the industry by changing the way it does business. Its philosophy has led to growth. GeoShack has grown from 8 to 24 locations by focusing on customer education and advanced support with GeoShack University and our GeoShack Advantage programs, as well as recruiting key people from different professions to diversify the company.

The technology to impact dramatic change in the industry is here. GeoShack has always been known as the place to go for the needs of surveyors with existing GPS and Robotic solutions. Now, with UAV's, mobile mapping, as



**Scott Beathard,
CEO**



GeoShack

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info@geoshack.com

well as BIM and scanners, GeoShack has embraced these new technologies and sees tremendous opportunities for professional surveyor's growth in 2017.

Some of the most exciting changes in the way the survey profession manages its workload is through UAV's, mobile mapping and terrestrial scanners. UAV's, mobile mappers and scanners deliver quick, easy and affordable aerial map where and when a surveyor or client needs them. GeoShack's solutions looks to be a game changer for 2017. UAV's and mobile mapping technology brings high speed, high density, and Geo-referenced, point clouds and imagery.

There are several reasons why land surveyors are increasingly adding drones to their portfolio of instruments. UAV's bring a whole new level to what is possible when capturing data and

imagery, opening up a diverse range of mapping & surveying possibilities. Using a drone can vastly reduce the time spent collecting accurate data. By acquiring raster data from the sky – in the form of geo-referenced digital aerial images, with resolutions as sharp as 1.5 cm (0.6 in) per pixel – a surveyor can gather millions of data points in one short flight.

Many of GeoShack's surveying customers say, for example, that large jobs that once took weeks can now be completed in just a few days, and that a week's worth of traditional data collection is now achieved in just one day. And, less time spent on the ground means staff safety is improved by minimizing risk to surveying teams when measuring sites such as mines, unstable slopes and transport routes. Simply choose take-off and landing locations that are out of harm's way.

GeoShack is North America's largest Topcon dealer, offering a wide selection of Scanners, UAV's, construction lasers, total stations, robotic instruments, GPS Survey systems, optical instruments, and 2D & 3D machine control systems for a multitude of applications.

Scott Beathard, President and CEO of GeoShack stated, "The unprecedented, rapid evolution of UAV's, scanners and construction software technologies in recent years has created tremendous opportunities within the Survey field for those who recognize and embrace both its necessity and potential." "2017 looks very bright as we will be able to support a surveyors or contractor's project with the best tools and services available, from start to finish."

New technologies create new opportunities. Surveyors who have already embraced these new technologies are already seeing dramatic benefits and additional profits for their businesses.



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25 Years and Counting...

It has been over 25 years since the advent of commercial lidar solutions, yet the industry continues to re-invent itself as new sensors, applications and business models appear. However, one constant remains: the drive to deliver more for less. Manufacturers and service providers alike continuously push the envelope, spurring performance and accuracy higher while seeking to drive capital and operating costs lower. It is around this vision that Teledyne Optech has built its strategy.

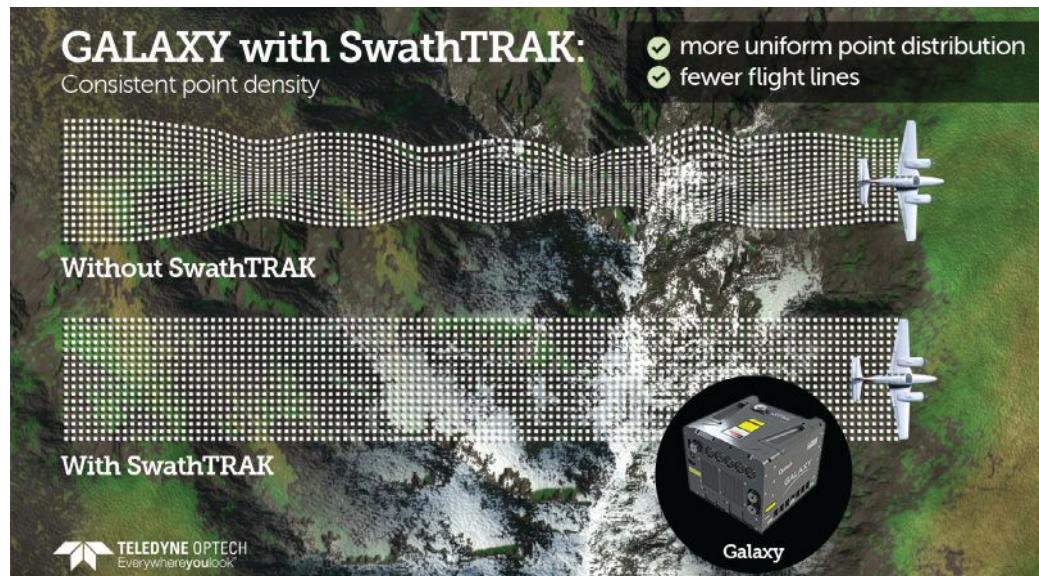
SMALLER, FASTER, BETTER...

Sensor innovation can be characterized in many ways, and the old adage of "smaller, faster, better" is particularly true with Teledyne Optech's latest sensors as we continue to enhance performance and accuracy while delivering ever-higher cost efficiency.

The ALTM Galaxy embodies this innovation — quite simply the smallest, most versatile and highest-performance airborne sensor on the market. Its fully programmable scanner now incorporates a revolutionary dynamic field of view for fixed-width data swaths even in highly variable terrain, thereby dramatically increasing collection efficiency and producing very predictable point spacing. The result: a major reduction in data collection and processing costs, which has made the Galaxy a hit with companies looking to leap forward in productivity and competitiveness.

Meanwhile, the newly released Lynx HS-600 mobile sensor builds on a proven platform to overcome the single biggest bottleneck to high-resolution surveying: the number of scan lines per second. By increasing the scan frequency to 600 lines/second — more than double its closest competitor — Teledyne Optech here again delivers market-leading efficiency.

The new Maverick mobile mapping



How a dynamic FOV improves efficiency in rugged terrain

system proves that smaller and cheaper is indeed better. 100% wireless, incredibly light and compact, the Maverick sets a new standard in versatility by handling a variety of applications for integrated lidar and imagery data. Mount it on a vehicle in under 10 minutes, or on a railcar with our unique magnetic mounting, wear it on a backpack, or ride with it on a Segway.

Finally, the brand-new Polaris TLS provides a unique level of quality, capability and range performance, all at the price of a short-range tripod-mounted laser scanner, with three



**Michel Stanier,
General Manager,
Teledyne Optech
Incorporated**

models to fit any application. By combining Teledyne Optech's renowned lidar data quality, long range, high collection speeds, integrated cameras and a host of features and software, the Polaris is a standard bearer for the direction of the industry.

MULTI-APPLICATION

For the first time ever, a single sensor can address numerous applications without compromise. It also reduces the financial risk associated with single-application sensor investment, particularly for bathymetry. The multispectral, multi-application Titan airborne system does not just collect seamless, high-resolution topo/bathy data; it is also the first lidar sensor capable of mapping vegetative differences and producing improved land classifications, by day or night, via its three inde-

pendent active wavelengths. This technology sets a new standard for active environmental mapping sensors by delivering much more information than simple coordinate measurements.

UAS/RPAS LIDAR

The relevance of UAS as low-cost platforms is clear, but their ability to produce survey-grade data at an acceptable price point is still up for debate. Instead, new autonomous sensor solutions on larger manned/autonomous platforms offer much better performance and cost efficiency.

Teledyne Optech's recent introduction of the Eclipse autonomous mapping sensor fills this gap. With no operator required, it literally operates itself, providing >4 pts/m² and high-resolution imagery from a small aircraft at up to 1000 m AGL. This approach reduces operating costs for smaller projects where a higher-performance sensor is overkill but a UAS solution is impractical or inefficient.

Another example of how Teledyne Optech continues to enable the industry to do more... for less!



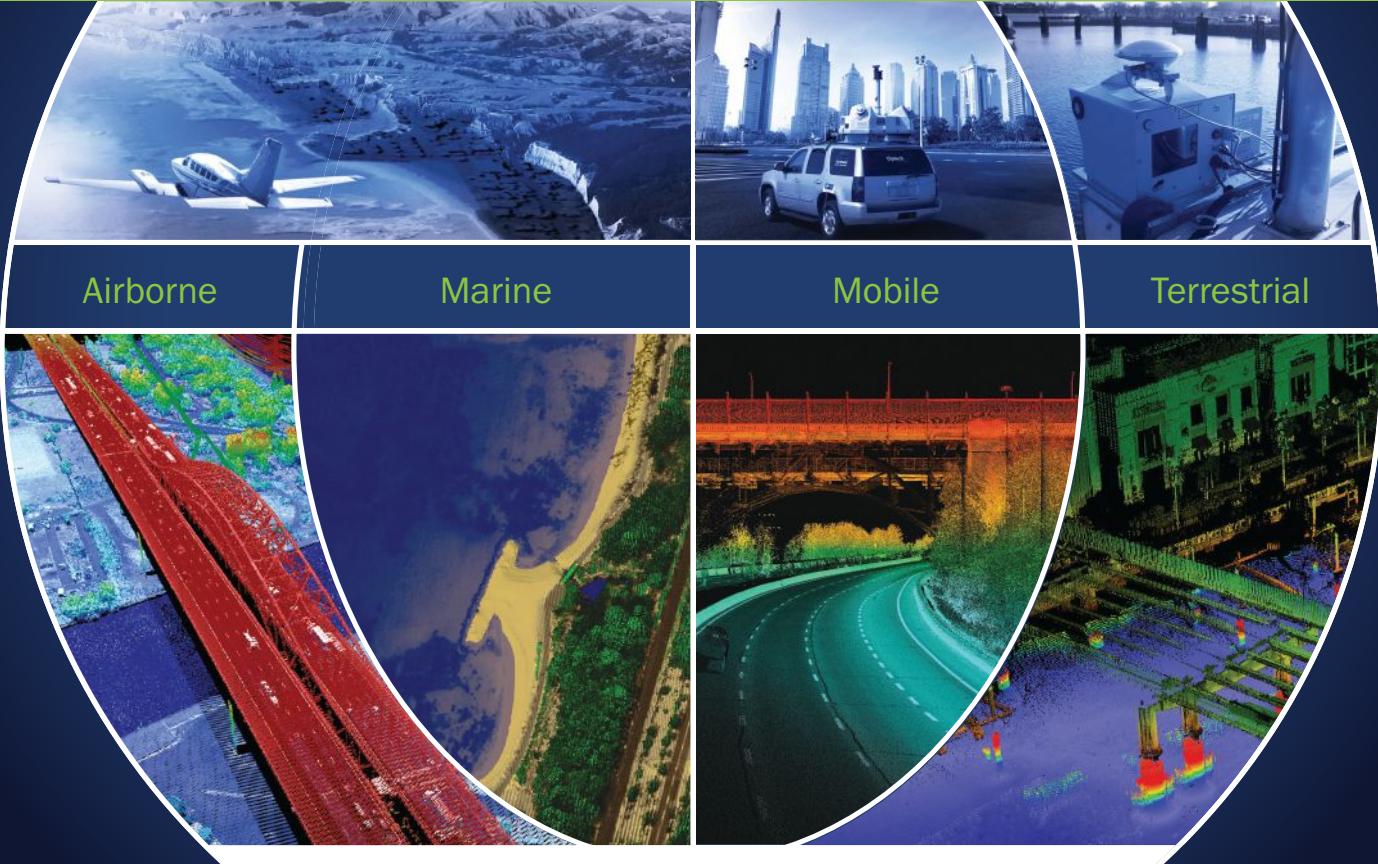
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Contact a Teledyne Optech representative today, and they will help you configure the appropriate sensor mix for your specific project needs.

www.teledyneoptech.com

Surveying and Mapping Trends

Certainty 3D sees the rapid acceleration of three fundamental trends in survey/mapping technology for 2017: 1) Point cloud data production, 2) Data Commoditization, and 3) Data integration across operations.

LiDAR systems are quickly moving from "cutting edge" to "standard" equipment status throughout the industry. LiDAR point cloud production is being increasingly supplemented by low cost UAV camera technologies. These systems will collectively increase point cloud data production exponentially in the coming year.

Increased levels of technology and workflow standardization will lead to further commoditization of point cloud and related data. This



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will drive the need for efficient and economical data administration.

Finally, data will continue to move beyond survey/mapping departments as point clouds are integrated within downstream design,

engineering, construction, and maintenance operations.

New software tools designed for extracting measurements, models, and GIS data applicable within the context of specific operations will accelerate this integration. Certainty 3D continues to offer workflow and software solutions to facilitate these trends.

TopoDOT® point cloud processing software features a collection of tools dedicated to supporting data quality assessment. The TopoCloud™ feature offers a data administration workflow designed to efficiently organize, store, and share data across practically any private and/or public cloud storage medium. TopoDOT®'s advanced

tool suite continues to offer higher levels of automation and accuracy as we develop focused applications integrated within design, engineering, construction, and maintenance workflows.

Thus TopoDOT® is positioned strongly to facilitate these geospatial trends in 2017 and beyond.



Ted Knaak, President

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Delivering Location Content

Location content is being tightly woven into the technology fabric of our everyday lives. It's appearing on mobile devices, desktop solutions and information kiosks. Why the surge? Businesses and governments recognize it drives faster, more reliable decisions. Deploying resources on site – people, vehicles, equipment – is costly and time consuming. We're living in a world where instant access is a mandate. Customers and citizens have embraced location content applications. They trust them and want more.

The best location content relies on a blend of data and aerial imagery. This powerful combination yields new forms of intelligence.



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Patrick Quigley, SVP/GM of Nearmap US

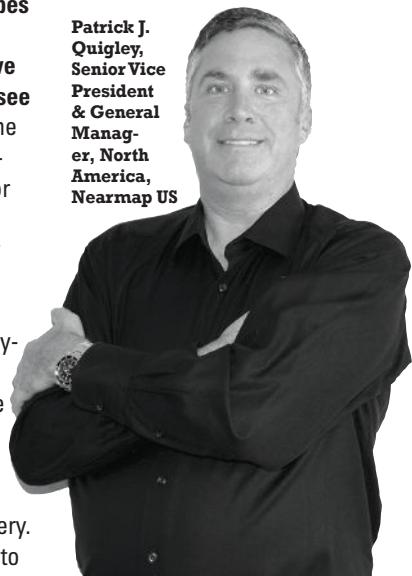
But that's not enough. **Aerial imagery has to be current and instantly available for this to work. It should be tightly integrated inside GIS and CAD. Clear im-**

agery provides an unprecedented ability to visualize the details in buildings, streets, landscapes and projects. This new approach is driving a competitive advantage allowing users to see change over time. Imagine the ability to deploy resources using imagery on your desktop or tablet? Imagine the ability to estimate, quote faster, quickly build proposals and win more business?

At Nearmap, we believe anyone involved in planning, design and construction - anyone deploying resources on-site - can increase productivity and customer satisfaction using high resolution aerial imagery. At Nearmap, we're committed to

delivering location content that transforms the way you work.

Patrick J. Quigley, Senior Vice President & General Manager, North America, Nearmap US



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More aerial insights as senseFly's vision widens

On June 21, 2016, the FAA published the final version of its small unmanned aircraft system (sUAS) regulations. Since the new regulations came into effect in late August, it has eased the administrative burden of commercial and governmental drone operators across the United States, significantly lowering the barriers to entry for this emerging market. Looking ahead at the future of the surveying industry, there is immense potential for growth in the United States, and at senseFly we plan to be at the forefront of this boom.

FLYING WITH EASE

senseFly customers all over the world have piloted more than 330,000 flights to date, logged more than 100,000 flight hours and mapped more than 30 million acres of land. For 2017, we foresee these figures rising dramatically as mapping drones become mainstream surveying tools capable of providing better insights than those obtained from traditional instruments, revolutionizing how surveyors actually work.

As such, we will continue to focus our efforts on providing full solutions to customers through our robust reseller network, which provides customers with a skilled direct sales contact. From hardware to data management and analytics, to insurance and financing, to maintenance plans and fleet management—all of these elements are essential to breaking down the barriers that hold back professionals from adopting drone technology. More game-changing partnerships with companies such as Skyward, Maptek and Air Navigation are also in the cards.

As the number one professional mapping drone manufacturer, senseFly's ongoing goal is to reduce obstacles that make it difficult for professionals to use drone technology. To accomplish this, we remain focused on continuously improving our products to suit the needs of end-users in every target market. For example, our latest release—the eBee Plus photogrammetry drone—is our most geospatially-focused system to date, offering upgradeable RTK/PPK for survey-grade accuracy, greater coverage per flight thanks to its flight time of almost an hour, and included our senseFly S.O.D.A. sensor, designed specifically for photogrammetry. These targeted improvements not only set a new standard in drone surveying, especially combined with the efficiency-driving features in our latest ground station software, eMotion 3, such as multi-flight missions—just land, swap out the battery, and re-launch to continue the same flight plan.



Jean-Christophe Zufferey

THE FUTURE OF DRONE DATA

Data has become one of the key drivers of almost every business in today's transforming world, and the ability to produce and analyze quality data on-demand is set to become a critical component of any successful business or venture.

A great example of this is when the transportation-engineering firm, J.L. Patterson & Associates, Inc. (JLP, now Zephyr UAV) surveyed a 30-mile rail corridor using an eBee RTK. JLP's team used the drone's provided flight planning software to set a 3.6 cm per pixel ground resolution. To map the dense urban corridor, JLP's three drone staff flew 41 flights. These missions captured 11,800 images, with an average flight time of 28 minutes and average flight altitude of 200 feet. JLP was able to collect ortho-rectified images at 3.8 cm per pixel, which is twice the resolution of even the



best manned aerial product. The data models JLP produced showed accuracies of down to one inch for both vertical and horizontal, which JLP's vice president, Marc Cañas, described as "the kind of accuracies you can only dream of with conventional aerial methods."

Thinking forward, drones and the data they capture will become more accessible and used more widely by professionals in virtually every industry as organizations become aware of this technology's safe and efficient information-gathering potential.

INVESTING IN THE RIGHT TECH

At senseFly, thanks in part to our founders' aviation backgrounds, safety is our top priority. The proprietary autopilot at the core of all our products features numerous automated failsafe behaviors and is the result of years of research and development. We selected the best miniature sensors, carefully characterized them, designed the electronic circuit boards to accommodate them and programmed the microcontroller ourselves in order to create the smallest, smartest and lightest autopilot in its class. Investing in the artificial intelligence of autopilots not only ensures our products are safe to use, but it makes them easier to use as well. Combine that with the lightweight, shock-absorbent construction of our eBee drones and you have an ultra-safe, globally-trusted data collection tool that customers return to again and again.

— By Jean-Christophe Zufferey, senseFly CEO



Aerial **efficiency**,
photogrammetric **accuracy**

www.senseFly.com/eBeePlus



Large coverage for optimal efficiency

The eBee Plus can map more acres per flight, than any drone in its weight class, allowing you to maximize your efficiency and plan projects with confidence.

High Precision on Demand (HPoD)

The eBee Plus includes built-in RTK/PPK functionality that can be activated either out of the box or later when required. It's survey-grade accuracy you control, without the need for ground control points—for less time in the field and more time putting your data to work.

Project-perfect payloads

The eBee Plus offers a camera to suit every application, including the senseFly S.O.D.A. (supplied), the first camera designed for photogrammetric drone mapping.

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From Missouri to Maine

With ten locations spanning from Missouri to Maine and over 50 years of combined experience, Topcon Solutions Store continues to be a leader in advanced technologies and products. Our industry product lines span many different industry segments. We can take you off the ground with our full line of Aerial Mapping products, or we can keep your job-site managed and connected to the office with our advanced software. We truly are the total solution.

Cameron Balls came to Topcon Solutions Store as a service assistant in 2011 quickly progressing to



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the position of Technical Sales Specialist, selling and training contractors and engineers on how to be productive with new technologies. Since then he has had the opportu-

nity to be a part of a continuously growing business and has excelled in introducing TOPCON positioning products, including machine control, GPS and optical solutions to the industry.

With this type of young technical talent the new Topcon Solutions Store group sees a future focused on Big Data offering software solutions, fixed, mobile scanning and aerial mapping solutions. Combining with technical support specialists, we continue to grow our business as we keep our customers up-to-date on the latest in technological advancements. With our industry product lines growing more complex every day, it is important



Cameron Balls

we continue to invest heavily on technology, support and training.

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Expanding our Portfolio

Point Clouds, Virtual Reality and Unmanned Aircraft Systems

Celebrating our 30th anniversary in 2017, we continue to explore new technologies and expand our portfolio with point cloud modeling, virtual reality applications and UAS. These tools complement DAT/EM's core business, our photogrammetric software line, Summit Evolution™.

POINT CLOUDS

Used by industries like transportation or civil engineering that require extreme accuracy, DAT/EM's point cloud editing software, Land-Scape™, contains a wide variety of tools to create, modify and classify points and draw vectors based on those points. We added several interactive point editing

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tools for smoother functionality and to provide users with unrestricted control over their data.

VIRTUAL REALITY

DAT/EM's newest software ambition uses virtual reality and the latest

DirectX 11 technology for extremely fast stereo rendering of point cloud projects with billions of points. Imagine being able to view the desktop and CAD or GIS window, snap to points and surfaces, and digitize 3D vectors while virtually flying around the points. The DAT/EM Virtual Reality™ technology is an evolutionary alternative to the 3D screen which will change the landscape of 3D stereo software solutions.

END-TO-END UAS SOLUTIONS

DAT/EM, with several major UAS processing software companies, is creating a user-oriented, seamless workflow. Capture imagery with UAS, upload the data into UAS orientation software and view the

stereo models or the resulting orthophotos with Summit Evolution technology, from Summit UAS™ to the more fully featured editions. Compile highly accurate 3D vectors and information suitable for inspections, topographic mapping, engineering, farming, forestry or conservation projects.



Jeffrey Yates,
General Manager

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Moving with the Times

Flexibility and strategic thinking are keys to growth in 2017

It goes without saying that we are in challenging and dynamic economic times. And current conditions are likely to continue. In its June 2016 Global Outlook, the World Bank projected a global economic growth rate of 2.8 percent for 2017, rising to 3 percent by 2018. The World Bank forecasts that developed nations will experience slow but steady improvement, while emerging markets, often dependent on exports, face continuing pressures from low prices and variable economies of consumer nations.

From the geospatial perspective, certain core economic drivers are shifting. While housing, commercial construction and infrastructure projects remain strong in many areas, the downturn in commodity prices (think coal and corn) together with a glut of oil and gas is swinging activity from the traditional energy sector to segments such as transportation, utilities and renewable energy.

That said, changes within the slowing energy segments can continue to drive growth.

For example, as a result of technological advances, production of oil and gas in North America is occurring in new locations. That in turn is driving development of transport infrastructure including pipelines and rail. Rail growth adds activity in track construction and maintenance as well as manufacturing for more and safer rail cars. The added load on the rail

infrastructure entails more inspection and maintenance of tracks and facilities. New safety regulations, such as the Positive Train Control (PTC) initiative in the U.S. call for massive amounts of geospatial data. Global expansion of renewable energy, which is often produced far from the cities where it is consumed, is driving creation of new transmission lines as well as development of production sites.

GEOSPATIAL SHIFT

Geospatial professionals are already reacting and—even better—anticipating the change. Surveying and engineering companies once



Ron Bisio



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focused on oil and gas exploration are leveraging existing knowledge to expand and shift their capabilities. For example, a firm experienced in oilfield operations may already have the safety equipment and training needed to work in refineries, factories or other industrial settings. They can add scanning, modeling and industrial surveying to their list of services and take advantage of the growth in plant maintenance and upgrades. Similarly, a geospatial service provider focused on pipeline construction has valuable experience in long, corridor-oriented projects. That experience can readily move into segments such as transportation and electricity transmission lines.

Significant opportunities exist in developed regions, where local and regional governments work to expand and modernize urban infrastructure. Rising popularity of infill projects (which help reduce urban sprawl and create resilient communities) is driving demand for detailed spatial information for planning and construction.

Geospatial professionals would do well to keep close watch on trends in their geographic regions as well as their areas of expertise. Are energy companies looking to bring solar, wind and potentially tidal energy production into the region? How will changes to sea level impact real estate

and infrastructure? What types of services are important? In these markets, a geospatial provider might add services such as data collection for beach erosion, jetties or hydrographic surveying. Similar analyses may be centered on change or growth in agriculture, mining, construction, manufacturing and transportation.

TECHNOLOGY: THE STRATEGIC TOOL

On the technological side, geospatial manufacturers are combining precision and efficiency with flexibility and customization to deliver productive, client-focused solutions. Systems built on blended technologies such as mobile mapping, UAS and imaging enable geospatial professionals to optimize return on their investment in hardware and software. Many geospatial technologies are capable of producing good results in multiple applications. For example, the Trimble® SX10 Scanning Total Station can function as a total station to provide precise optical positioning for surveying applications. It can also capture high-quality 3D point clouds for inspections, architectural uses and other applications that previously called for a dedicated scanner.

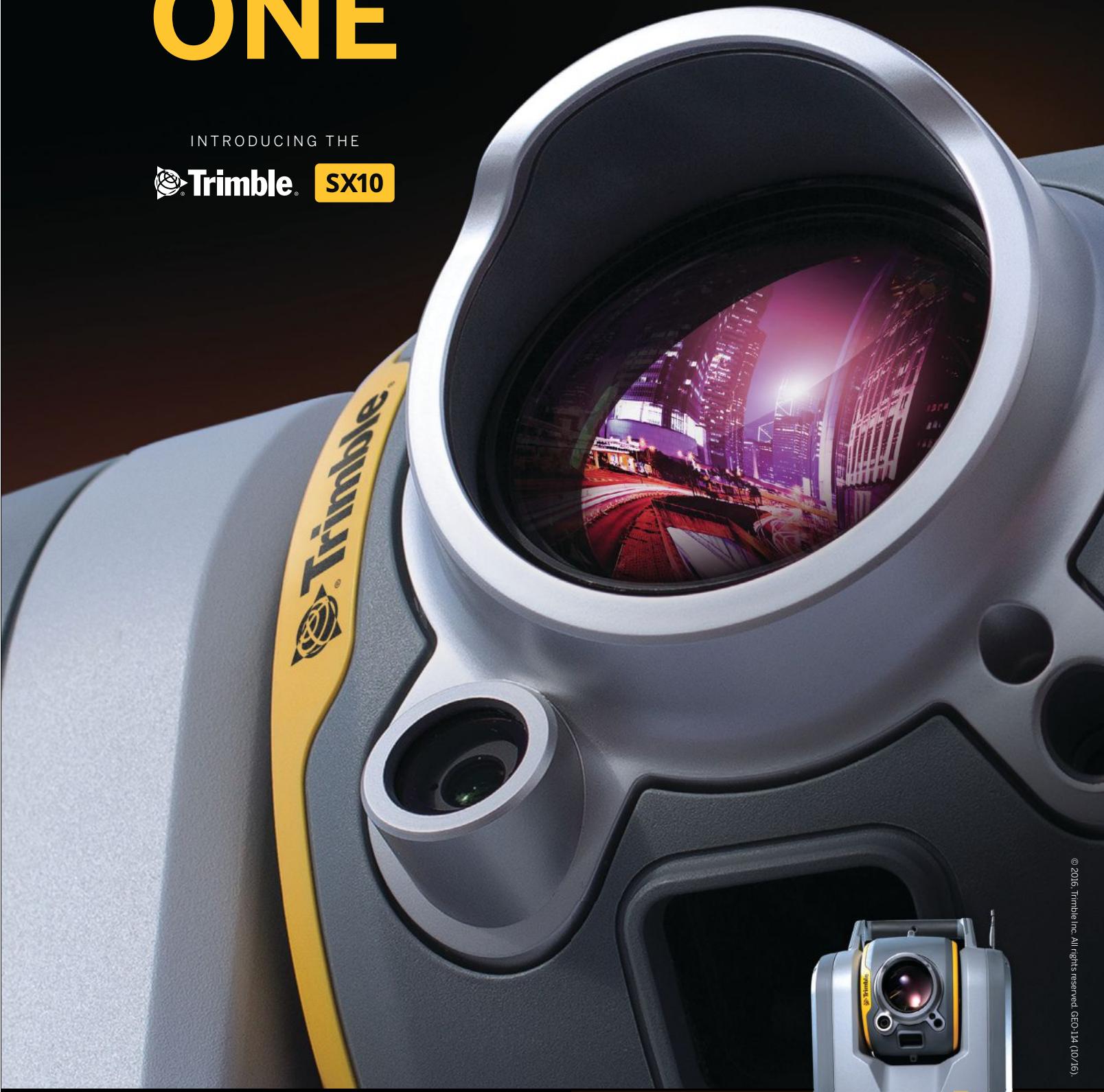
The expanding options in positioning technologies provide geospatial professionals with a high degree of flexibility in making business decisions. As geospatial service providers look at their markets and identify new opportunities and strategies, they must be confident in their ability to provide high-quality deliverables and services. New geospatial technologies in the field, office and cloud will enable them to select and implement efficient, profitable solutions for their clients' needs.

—By Ron Bisio

AND THEN THERE WAS **ONE**

INTRODUCING THE

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The Trimble® SX10 total station is a revolutionary piece of surveying equipment—one machine with full **total station technology** plus a **high-precision scanner**, united at last. Welcome to innovation powerful enough to redefine an entire industry.

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The future of mapping and Microdrones®

A conversation with Vivien Heriard-Dubreuil

Vivien Heriard-Dubreuil is the President of Microdrones, the company that developed the world's first commercial VTOL aircraft. He recently sat down to discuss the future of Microdrones and the UAV industry.

xyHt: Microdrones has been around for more than a decade. Has the company's vision changed since it was founded?

Heriard-Dubreuil: Definitely – though I'm sure the handful of other UAV companies that have been around this long would say the same. Ten years ago the company's goal was to develop the best commercial quadcopter in the world. Microdrones accomplished that. Today, we're focused on providing just the right solutions for industries that need our aircraft most: surveying, mapping, inspection, and precision agriculture.



Microdrones President Vivien Heriard-Dubreuil and Michael de Lagarde, CEO of Delair-Tech will be working together to supply Trimble dealers and customers with a full line of VTOL and fixed wing UAVs, as announced during the Intergeo Show in Hamburg, Germany earlier this year.

xyHt: Do you think those industries represent the future of the commercial UAV industry?

Heriard-Dubreuil: They represent a big part of it. Mapping in general is where I feel you'll see the greatest advances, both technologically and in use. It's an exciting sector, too, because accuracy is so important and requires the very best vehicles, hardware, and software. You're going to see drones used more and more by surveyors, cartographers, topographers, photogrammetrists, civil engineers, and geographers – basically global information systems (GIS) professionals.

xyHt: How is Microdrones working to meet the needs of GIS professionals?

Heriard-Dubreuil: We recently released four complete VTOL UAV mapping packages. These solutions have everything needed for specific applications. The mdMapper200 is competitively priced, compact and lightweight, yet flies 20-25 minutes in less-than-ideal conditions. You can cover 30 hectares in a flight, which is a good entry capability and enough for many users.

Our mdMapper1000 package features our most popular UAV, the md4-1000. Users love this model because it provides industry-leading flight times up to 45 minutes with a heavier payload. It's resilient against environmental challenges like extreme temperatures, strong winds, magnetic fields, and harsh weather. With this solution, you can map twice the area

Table 1

Workflow Task	mdMapper1000	1000DG	Difference
Plan Project	1 hr	1hr	-
GCP Layout	2 hrs	-	2 hrs
Flight	35 mins	15 mins	20 mins
Data Processing	12 hrs	4 hrs	8 hrs
Total	15.35 hrs	5.15 hrs	10.20 hrs

Table 1: microdrones compared their best-selling mdMapper1000 with the mdMapper1000DG. The second solution includes direct georeferencing. The first does not. The difference in work efficiency is dramatic.

per flight compared to the mdMapper 200.

xyHt: Can you tell us more about that?

Heriard-Dubreuil: Certainly. If you want to know what the future of GIS is, direct georeferencing with UAVs is it. DG dramatically shortens the amount of time spent while achieving the highest level of accuracy. It reduces or eliminates the need for ground control points. And it requires less front and side overlap, so it can cover more ground in much less time and collect far fewer images. Post-processing is done in a fraction of the time.

xyHt: Impressive. So the equipment pays for itself by making users more efficient and competitive. What about the last package?

Heriard-Dubreuil: mdMapper3000DG is our most advanced solution. It accomplishes all the same as the mdMapper1000DG in terms of direct georeferencing, but includes our md4-3000 aircraft. This UAV can carry a payload between 7 and 15 pounds.



Microdrones

Website: www.microdrones.com

Email: info@microdrones.com

Sells Worldwide, with offices in:
Rome, NY (USA)
Siegen (Germany)
Vaudreuil-Dorion, QC (Canada)

Number of Employees:
70 and growing

xyHt: Wow! That's a lot.

Heriard-Dubreuil: (Laughs) Yes, a very big payload. It can carry heavy LIDAR sensors, professional mapping grade cameras, multiple sensors, and other heavy equipment.

xyHt: And these solutions are now available through Trimble?

Heriard-Dubreuil: Yes. Microdrones is now their preferred provider of VTOL aircraft and Delair-Tech is providing fixed wing. We're pleased because this partnership helps us advance our mission for the future: making it simple for customers to get their hands on complete, cutting-edge microdrones aerial mapping solutions.



Right now, in addition to expert guidance, the microdrones team will provide you with **FREE POST PROCESSING** of your first 60 acres/24 hectares.* NO PURCHASE NECESSARY. Simply send a relevant mapping question to: surveying@microdrones.com

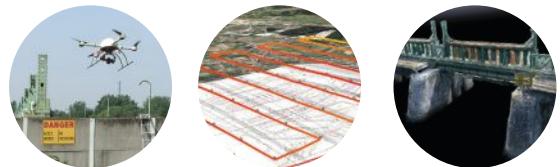
*Images should be provided geotagged with sufficient overlap, and in an RGB color (.tif or .jpg) format. Please contact us prior to your flight if you want further information. microdrones management reserves the right at its sole discretion to refuse this offer if your application is not relevant to commercial surveying/mapping, or if your existing data/photos are incompatible with our capabilities.



SO EFFICIENT, YOU'LL BE LOOKING FOR NEW HOBBIES

mdMapper1000DG is an integrated aerial mapping solution that employs direct georeferencing. It helps you achieve survey grade accuracy using fewer ground control points – or no ground control points at all.

A microdrones md4-1000 aircraft is paired with a survey-grade GNSS receiver and a precisely calibrated IMU for mapping. Images are collected via a 42.4 megapixel camera paired with a custom, lightweight, vibration-free, nadir mount.



You'll be able to survey hard-to-reach or dangerous sites without risking human injury. And because every microdrones aircraft is built with specially molded carbon fiber, you won't be sidelined on harsh days that involve moisture, sand, or salt. No ground control points, less sidetrap, more productivity.



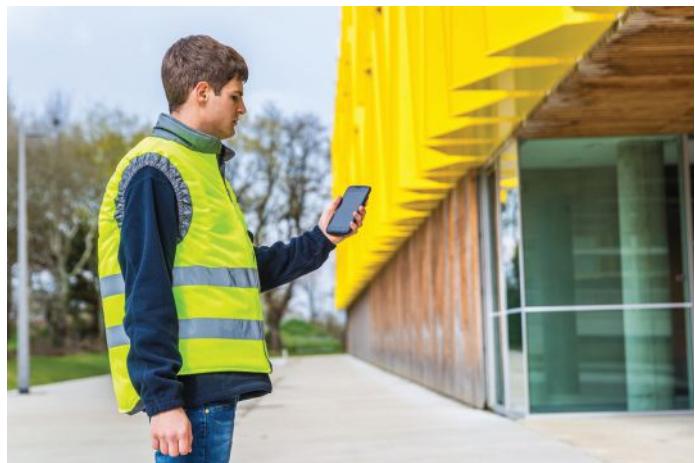
Spectra Precision Leads By Empowering Customers

The Spectra Precision brand experienced continued growth in 2016 by providing customers with cost-effective products, software and services tailored to their specific process and work environments. In addition, Spectra Precision further consolidated its business practices with Trimble to enhance synergies and teamwork that enables an expanded breath of customer-specific solutions.

Spectra Precision survey and geo-spatial products are designed to meet the specific needs of the conventional surveying market. Product development focuses on delivering products that get the job done. Spectra Precision targets the mainstream users in both developed and emerging countries who are looking to achieve the greatest efficiencies for the lowest cost. With a focus on the surveying and construction market, Spectra Precision products offer the most straightforward solution to best meet the problem. The 2016 product portfolio includes an array of GNSS and GIS solutions, as well as optical total stations, data collection hardware, field and office software, and a wide range of construction tools.

- In 2016, Spectra Precision was particularly proud to announce a robotic total station with the longest battery life on the market. We were able to meet market demand for longer field life, without battery swapping, by engineering our Focus 35 robotic total station to strip out non-essential drains on battery life with no compromise in the high speed of observation and precise positioning. Suitable for virtually any type job, the Focus 35 especially excels in construction layout. It continues to be a big hit for us in the market -- winning strong approval in the US, Europe and globally.

Olivier Casabianca, General Manager of Spectra Precision and head of Marketing for Trimble Surveying and Geospatial Division



- Another 2016 new product, showing strong adoption is the SP60, an entry-level receiver offering mapping grade accuracy levels. A dual-band GNSS solution, the SP60 is scalable and highly versatile. It's designed to work well with third-party Android controllers and applications software. As a result of our enhanced synergies with Trimble, the SP60 is equipped to receive Trimble RTX correction streams directly from the sky, enhancing calculated positions.

- Also in 2016, we debuted the MobileMapper 50, a data collec-

tor and controller, delivering a smart phone device experience, in a rugged and waterproof design. Running on Android, it ships with its own software solution and importantly allows developers to easily develop and load their own software for the special needs of their regions and markets.

In 2017 and beyond, Spectra Precision will continue to develop and deliver exactly the right products with just the right amount of functionality to be able to very effectively compete for the attention of most demanding users. Our focus remains on users



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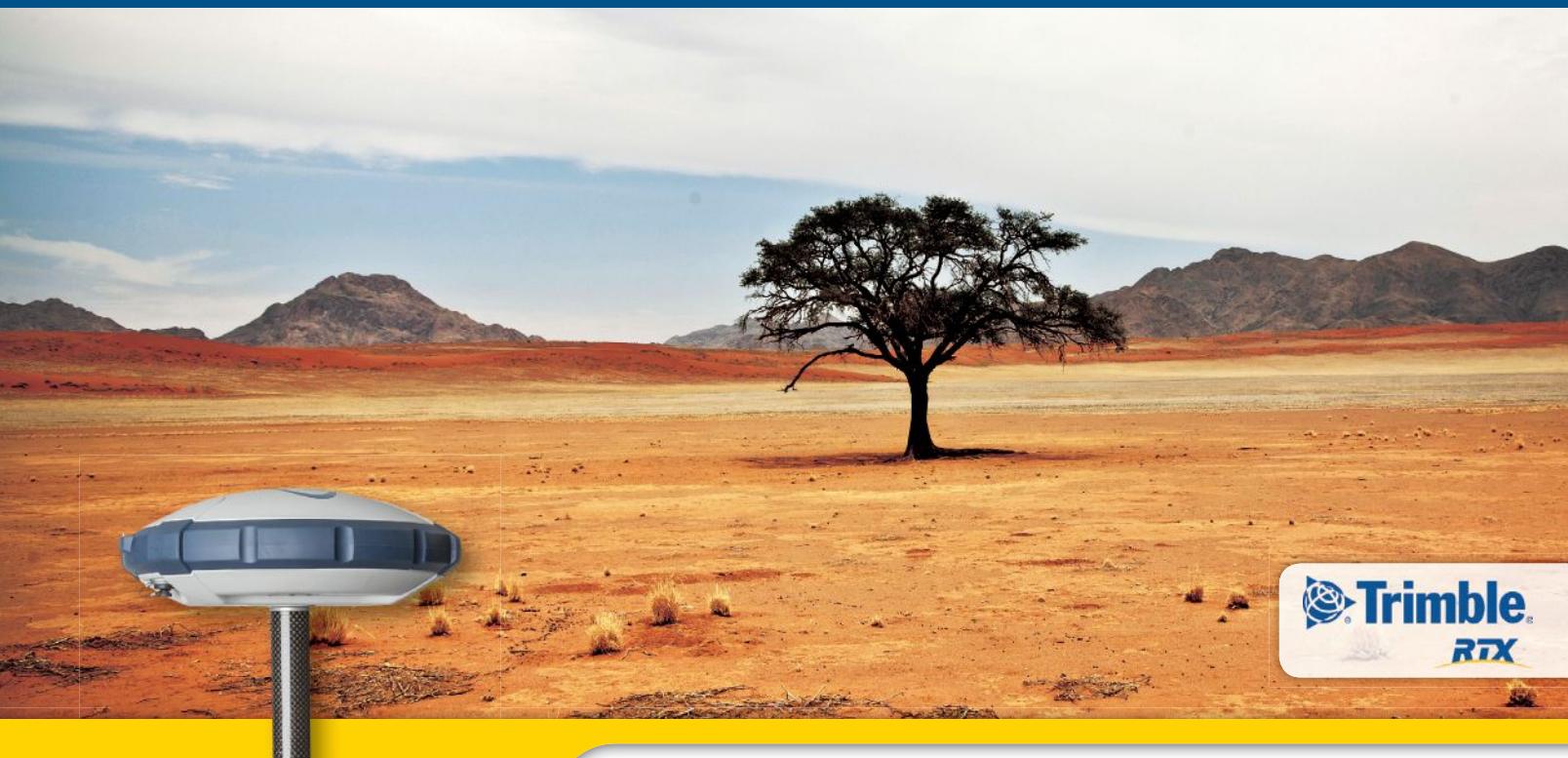
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keeping an eye on costs and maximizing their efficiency. We bring our products to market with strong support through distribution channels that provide the flexibility to compete very effectively across a wide geospatial spectrum around the globe. Keep an eye on Spectra Precision in the coming year and the years ahead. We expect to bring some very nice changes in the market to continue our tradition of empowering our customers to achieve greater efficiency and growth while expanding our own technology portfolio.

Wherever You Are



Features

- Extended survey scalability
- New 240-channel 6G ASIC
- Z-Blade GNSS-centric
- Trimble® RTX capable
- Internal TRx UHF radio
- Long Range Bluetooth
- Anti-theft protection



SP60

The most versatile GNSS solution

Challenging environments will no longer be a nightmare for you or your crew. The Spectra Precision SP60 is a new generation GNSS receiver offering a high level of flexibility to cover any survey demand from simple post-processing, through UHF or Long Range Bluetooth base and rover systems to sophisticated RTK and RTX rover solutions. Combining the unique all-signals-tracking and processing Z-Blade GNSS-centric technology and L-band capability for satellite-delivered Trimble® RTX service, the SP60 GNSS receiver provides the most reliable measurements and the highest possible accuracy under any conditions, anywhere in the world.

SP60 : Simply Versatile

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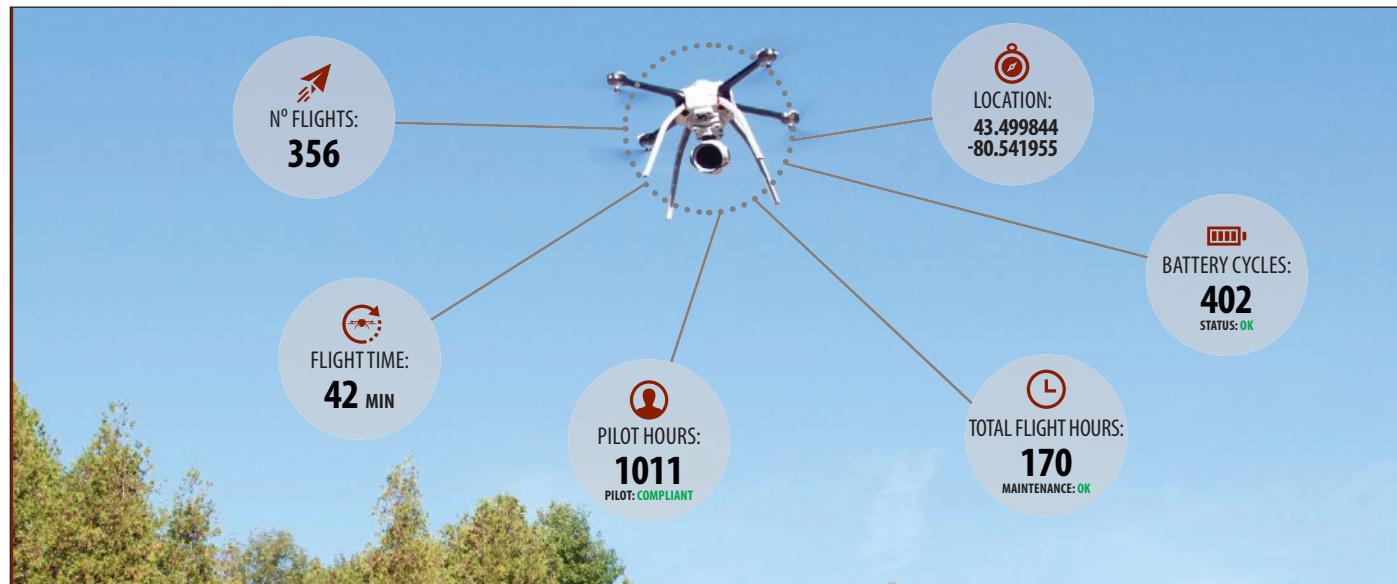
The Aeryon Unmanned Aerial Systems (UAS) platform is one of the most widely deployed small UAS in the world. With over 10 years of experience and almost 200 employees, Aeryon is engaged in continual innovative research and development – perfecting cutting-edge solutions for their clients. As an industry leader, Aeryon is a trusted provider of mission-proven UAS systems in 35 countries.



As UAS fleets increase in size and aircraft are flown more frequently, the need to maintain accurate flight logs and equipment records, and submit timely reports to regulators and insurers, becomes more challenging for UAS operators.

Aeryon addresses the demands of industry and government with its AeryonLive Fleet Management solution. This online platform automates a previously manual

process by maintaining an online connection to the UAS and providing deep, subsystem-level analytics on all aspects of usage and performance of a UAS fleet. This eliminates the risk of user error in record keeping, and presents a wealth of precise and detailed data on the aircraft and its subsystems (such as individual batteries) to help ensure airworthiness and maintain compliance with regulators and insurers.



AeryonLive™ – Automated sUAS Fleet Management and Aircraft Analytics

As UAS fleets increase in size and aircraft are flown more frequently, the need to maintain accurate flight logs and equipment records, and submit timely reports to regulators and insurers, becomes more challenging for UAS operators.

AeryonLive Fleet Management automates this previously manual process by maintaining a secure, online connection to the UAS and providing deep, subsystem-level analytics on all aspects of usage and performance of a UAS fleet.

Sign up for a **30-day free trial** and private training session at live.aeryon.com.

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Put Technology to Work for Your Firm

As surveyors, engineers and contractors are increasingly pressured to work faster with fewer resources, new solutions have been introduced that promise to dramatically increase productivity and efficiency. From more sophisticated data collectors and field software to more automated total stations and GNSS instruments, today's technology offers impressive capabilities that can make choosing the right solutions challenging. How can you be sure to maximize the value for your firm?

1. WORK WITH A REPUTABLE AND EXPERIENCED SOLUTIONS PROVIDER.

Making an investment in new technology gives you the opportunity to do more than just purchase a new



product. With the right provider, you can also gain access to a wealth of knowledge. Look for a provider that works with a variety of customers and applications and is able to share information to help you succeed. Does the provider carry multiple lines and multiple brands? Can they service and support everything they sell? These are also questions to consider when evaluating a technology resource.

2. BOOST YOUR KNOWLEDGE AND SKILLS WITH TRAINING.

Training is an essential part of an investment in any new technology. Look for a solutions provider that offers an in-depth training program with your purchase. Their goal should be to ensure your proficiency with the technology, whatever it takes.

3. TRY BEFORE YOU BUY.

As robotic total stations, laser scanning and self-learning GNSS have become more mainstream, professionals have become increasingly interested in trying out these new technologies before they buy. Renting is a great way to evaluate different brands to find the right match with your current workflows. Renting can also help

you meet project-specific technology needs. Look for a technology provider that can support you with a comprehensive rental program.

Whether you want to adapt new solutions to your current workflow or you are investigating a new workflow to make overall improvements to your business, our experienced staff can help you find the solution that best fits your needs. We have over 100 years of combined experience to help you secure the tools, training and rentals that are right for you and your firm. To speak to a knowledgeable representative, give us a call today or visit www.allenprecision.com to find out how we can help your business thrive in 2017 and beyond.

Whether you're in the market to purchase or rent gear from our huge lineup of the latest solutions, we promise the best customer experience in the industry.

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Easy to use e-commerce site

Chat LIVE with our knowledgeable staff

100% price match guarantee



The Online Marketplace for Surveyors, Engineers & Contractors



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Simple SaaS pay-per-month model, step out anytime.

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