

## Earth Observation Drives Innovation



Application of EO data



Interview with GEO



Feature extraction



Hurricane Irma



Mapping with drones

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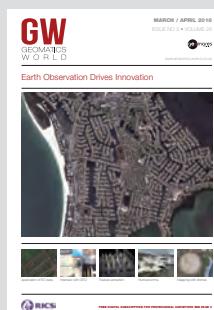
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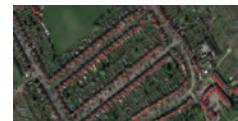


#### COVER STORY

The cover image is of Marco Island in Florida, USA. It was taken on 18 September 2017, 8 days after hurricane Irma made landfall in Florida at this location. The image was taken using one of the high resolution DMC3/TripleSat satellites with 1m GSD (80cm pixel size) and is available through Earth-i Ltd. All Rights Reserved.

### P. 16 SPACE ENABLED INNOVATION IN CITIES

Daniel Wicks reports on innovation using Earth Observation data encouraged by the Space Applications Catapult.



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Geomatics World talks to Steven Ramage, Head of External Relations at GEO, to discuss his role and Earth Observation internationally.



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David Selviah describes an innovative approach to generating data for BIM.



### P. 28 DRONES - A SURVEYORS TOOL

Charlton Bland, a chartered land surveyor, gives us details of a drone survey conducted in 2017.



### P. 30 HYDROGRAPHIC SURVEYING IN THE WAKE OF HURRICANE IRMA

Phil Payne gives his personal account of his experiences in the Caribbean.



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Richard Groom and Jason Poole report on the GeoDATA conference held last November in London.



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# Earth Observation and Artificial Intelligence

**The government of the United Kingdom is strongly supporting the UK aerospace industry and Earth Observation is an important component of that. In January, the UK government Science Minister stressed the importance of space in the UK industrial policy and particularly how young people will empower this sector. The UK is especially strong in building EO satellites, with SSTL a key component, and Airbus building Sentinel satellites in Stevenage. The UK also takes a lead in innovative applications.**

The theme of this issue is Earth Observation and we have an article from Daniel Wicks which covers activities in the UK with specific reference to geospatial surveying and an interview with Steven Ramage from The Group on Earth Observation (GEO) on the international dimension of EO and its importance in benefiting society. Other items in the magazine demonstrate the ubiquity of EO in many applications and the role that the UK plays in this. Gordon Johnston points out that EO is one of the sources of Big Data and David Selviah describes the use of artificial intelligence and machine learning in automatic processing. These techniques are becoming increasingly relevant to handling geospatial data and as autonomous vehicles and robots move from being novel aspects of science fiction to part of our daily lives we need to understand the implications to us all.

A key player in the increasing spread of the use of EO is the European Copernicus programme and a report from EARSC (The European Association of Remote Sensing Companies) on the internationalisation of the EO services industry outlines the importance of Copernicus in driving business growth. Will the UK still be able to use this major asset initiated by the EU after Brexit?

Two articles from *GIM International* in December give further body to this topic with articles on how EO can provide real-time information to improve our health (another Copernicus project) and how open access to EO data in The Netherlands creates many innovative applications. In Modus Dec/Jan we see the geospatial contribution to detecting earthquakes through DifSAR and to damage assessment; the UK has played a major role in developing this technology.

## KEEPING SPACE DEMILITARISED

I attended an interesting seminar before Christmas on Space Policy and Law to mark the 50th anniversary of the Outer Space Treaty (OST). The keynote speaker was Gerard Brachet, founder of SPOT Image and a former Director general of CNES and chair of UN COPUOS (Committee on the Peaceful Uses of Outer Space). Brachet emphasised the success of OST in keeping weapons out of space but noted that both USA and USSR had launched a vast number of EO satellites in the Cold War period from 1960 to 1980, which was an indication of what might have been. He also pointed out the current challenges of which space debris and the risk of collision were serious. Another speaker referred to the scenario of 'a day without space' which could threaten civilisation itself. It is not well known that Landsat 7 was hacked to the extent that it could have been taken over by cyber criminals.

We also have two items about the aftermath of disasters. Phil Payne writes about his personal experiences in the British Virgin Islands during Hurricane Irma and the report on the RICS lecture by Alan Mills from MapAction describes the critical importance of geospatial data in the response to disasters. EO data is an essential component of the data required.

The Editorial Board of *GW* met in February to plan future editions. The next issue will feature education and will also look forward to GeoBusiness. We welcome any comments on the content of *GW* and ideas for future issues. *GW* wants to serve the geospatial community in the UK and to do this effectively we need your feedback.



Ian Dowman, editor of Geomatics World

Ian Dowman, Editor

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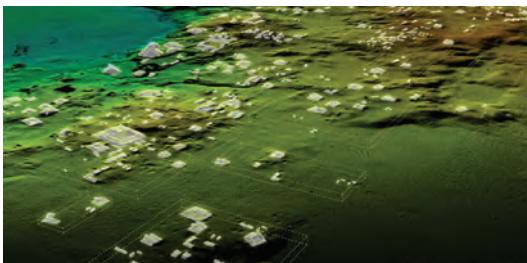
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## LIDAR REVEALS EXTENDED MAYAN RUINS

Teledyne Optech's Titan sensor was used by the University of Houston's National Center for Airborne Laser Mapping (NCALM) to reveal extensive Mayan ruins in Guatemala. LiDAR technology was able to identify hundreds of previously unknown structures, including raised highways, and complex irrigation and terracing systems.

After the collapse of the Mayan civilization, their cities and monuments were quickly covered by thick rainforest, hiding the ancient civilization from airborne observation and making it very difficult to survey on foot. Flying high above the rainforest, Titan's lasers penetrated the canopy to collect almost a million data points per second from the forest floor, giving archaeologists a "bare earth" view of the structures underneath.



## NATIONAL LIDAR COVERAGE

The Environment Agency has announced plans to survey England's entire landscape by 2020, using the data to assess flood risk and inform conservation work. Using aircraft equipped with LiDAR, the Environment Agency will map all 130,000 square kilometres of the country at 1m resolution. The data will be made available for free to the public and industry as Open Data.

"This ambitious project will enhance our understanding of England's unique natural features and landscape, helping to better understand flood risk, plan effective defences and fight waste crime," said Sir James Bevan, chief executive of the Environment Agency.

## OCEAN INFINITY SEARCHES FOR MH370

A new chapter in the search for Malaysia Airlines flight MH370 has

## IN BRIEF

Historic England has announced that the third edition of their technical guidance document, **3D Laser Scanning for Heritage**, is now available free for download from the HE website at <https://historicengland.org.uk/images-books/publications/3d-laser-scanning-heritage/>.

**Orbica** and partner **Reveal Infrastructure** are trialling a ground-breaking satellite-based augmentation system (SBAS), funded by the Australian and New Zealand governments, to see if it can pinpoint underground assets that have been dug up in urban environments.

One and a half million square kilometres of bathymetric seafloor data covering the **Great Barrier Reef** have been released to the public by Geoscience Australia under partnership with James Cook University and the Australian Hydrographic Service. The project carried out high-resolution bathymetric scans, which were combined with existing datasets held by the government to create the most comprehensive, detailed models produced to date.

**Fugro** has won a second major contract from the Norwegian Public Roads Administration (NPRA) for the **largest road project in Norway's history**. The work on the E39 Coastal Highway will involve a 1,100-kilometre-stretch from Kristiansand in the south to Trondheim in central Norway and is estimated to require investment of approximately NOK 340 billion.

begun with the announcement of Texas-based firm Ocean Infinity being hired to locate the missing wreckage. The announcement follows the suspension of the joint Malay-Chinese-Australian search for the missing plane in January 2017, following almost three years of intensive, but ultimately fruitless efforts to locate the fuselage and flight recorders at an estimated cost of US\$200 million.

The Ocean Infinity-operated vessel, Seabed Constructor, is believed to have already begun its search with its fleet of eight AUVs. It will scan the area identified by the Australian Transport Safety Board (ATSB) as the next most likely area for MH370.

"The oceanographic reason for why 35 degrees south is more likely than say 34, 33, or 32, is that at all those latitudes the current is

going to the east. So if the crash had been in any of those latitudes then there'd be a high chance of at least one or two things turning up in Australia. Whereas there've been 20 or 30 items turning up in Africa, and not a single one came to Australia. Once you start looking in the vicinity of 36 to 32, then 35 is the only option," said Dr David Griffin, who led the drift analysis for CSIRO.

Ocean Infinity's fleet of eight AUVs are equipped with a broad range of sensors including side scan sonar, multi-beam echosounder, sub-bottom profiler, HD camera, conductivity/temperature/depth sensor, self-compensating magnetometer, synthetic aperture sonar and a turbidity sensor. Operating from the Seabed Constructor, the AUVs are capable of 'flying' at depths between 5 and 6,000 metres.

## OSI JOINS RESILIENT CITIES

Ordnance Survey International (OSI) is the first national mapping agency to join the 100 Resilient Cities platform of partners (100RC). Pioneered by the Rockefeller Foundation, 100RC is dedicated to helping cities across the globe become more resilient to the physical, social and economic challenges of the 21st century. Amongst the cities that are members of 100RC are Bristol, Glasgow, Greater Manchester, London, Singapore, Melaka, Manama and Dubai. Other 100RC partners include Microsoft, Swiss Re, the World Bank, Mastercard, Veolia and Sandia National Laboratories.

OSI is offering 100RC network members a critical resilience building tool that assesses how cities collect their geospatial data, and how it's managed, distributed and utilised. Through the Geospatial Maturity Assessment, OSI will also be advising cities on improvements to their processes and technology for better, more effective geospatial data management and deployment in relation to the challenges they face.

## LIDAR AND BIM MARKETS ANALYSED

Research and consulting firm Esticast has projected a market value for the LiDAR industry at US\$1.5 billion by 2024 in their latest analysis. This projection represents a colossal growth of demand for LiDAR services in the intervening years, with the same report placing 2016's LiDAR market value at US\$332.2 million. The same company has published The Global Building Information Modelling Market report which forecasts that the global BIM market will reach US\$18.8 billion by 2024, up from a valuation of US\$3.6 billion in 2016. The report found that emerging countries in Southeast Asia and Europe will be major drivers of this projected expansion.

## EU RELOCATES GALILEO SATELLITE SYSTEM INSTALLATION FROM UK TO SPAIN

European Commission has announced that a part of the infrastructure for the Galileo satellite system will be relocated from the Britain to Spain because of the UK's departure from the EU. The back-up security monitoring centre for Galileo, Europe's advanced version of GPS, was originally awarded to London in 2010 after a competitive process. The centre, which was due to become fully operational later this year, controls access to the satellite system and provides around-the-clock monitoring of it when the main security centre, near Paris, is offline.

## GEOMATICS MEETS GEOSCIENCE AT THE 2ND VIRTUAL GEOSCIENCE CONFERENCE

The December 2017 issue of The Photogrammetric Record (volume 32, issue 160) is devoted to reports from the 2nd Virtual Geoscience Conference, which took place in Bergen in September 2016.

The conference was organised in response to the increasing convergence of geoscience disciplines such as geology, glaciology and natural hazards with geomatics due to the ubiquity of digital cameras and the availability of low cost UAVs and photogrammetric software. Geoscientists can now acquire their own application-dependent field data and are also increasingly using more advanced techniques such as hyperspectral and thermal cameras and interferometric SAR. A VGC Steering group has been formed to ensure that the VGC series of conferences continues, contact [simon.buckley@uni.no](mailto:simon.buckley@uni.no). The 3rd VGC will take place 22-24 August 2018 at Queen's University, Kingston, Canada - see <http://virtualoutcrop.com/vgc2018>.

## LEICA UPGRADES PEGASUS

Leica Geosystems has released the new Leica Pegasus:Two Ultimate, an upgrade to its current mobile mapping platform bringing higher-quality digital reality capture to the market. With the new mobile mapping platform also comes new >

### LET'S GEOVATE!

Geovate 18 took place at the RGS on 16 February. This one-day conference marked the third day of the Geovation camp, during which the ten best ideas from the latest challenge – Building Greener, Smarter Communities – were developed into ventures that can attract funding. The format for the day was a morning of talks and an afternoon during which the ten finalists presented their pitches to a panel of judges. Highlight of the morning was an inspiring presentation by Wayne Hemingway on his remarkable progress from Camden Market to international designer. The challenge winner was team 'WareHAUS' which was awarded £50k to progress their idea to build modular homes for 'key workers' within empty offices and warehouses. For more, visit the [www.geovation.uk](http://www.geovation.uk) and see the full report in GIS Professional.



# GEO

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mobile mapping software. The Leica Pegasus Webviewer is an online platform that visualises all captured data – stored completely in the cloud – from any browser.

Users can service new market segments, including Smart City applications by digitising road and rail infrastructures while expanding into new markets in support of autonomous vehicles, with seamless 360 and higher resolution imagery, and increased expansion ports for additional sensors. The platform removes the need for complicated six camera stitching by incorporating two back-to-back cameras creating a 24Mpx 360 degree image calibrated to the Lidar profiler - enabling digital reality captures forward and backward from automobile, train or boat. A high dynamic range is made possible by a large sensor to pixel ratio, allowing capture in a variety of lighting conditions and vehicle speeds.

#### **NEW TRIMBLE GNSS REFERENCE RECEIVER**

Trimble has unveiled its all new Alloy Global Navigation Satellite System (GNSS) reference receiver. Alloy is ready to take on the requirements of any real-time network, in any environment, anywhere in the world. With modernized satellite tracking, the receiver can be used as a Continuously Operating Reference Station (CORS) receiver, scientific reference station, a campaign receiver for post-processing, or portable base station receiver for real-time kinematic applications. It has a 100Hz logging rate with up to 12 logging sessions, is flexible in ports and communications options, has dual hot swappable internal batteries with integrated charging for flexible power management, and is designed to IP68 certification.

#### **DOXEL TAKES ON CONSTRUCTION INEFFICIENCY**

Doxel is an artificial intelligence and computer vision-based system

#### **EARTH-i LAUNCHES VIDEO CAMERA INTO SPACE**

On the 12 January, Earth-i, a British 'New Space' pioneer based in Surrey, launched its first technology demonstrator satellite, VividX2.

Earth-i's multiple satellites will be able to revisit the same location frequently to track change over time. The goal is to provide both global coverage and a near real-time data service from daily revisits and at multiple times per day.

Richard Blain, CEO of Earth-i, says that Vivid-i will be a game-changer for the Earth Observation (EO) industry – and for the multitude of public and private sector organisations that are looking at how insights from space will help them monitor, track and analyse activities, patterns of life and changes at any location on Earth.

The HD camera fitted to the Vivid-i satellites will be able to provide images of better than one metre for any location on Earth. Unlike other EO constellations, however, Vivid-i will be able to show objects moving at these locations – including vehicles, vessels and aircraft - with data available for download to a ground station in Earth-i's network within minutes.

This means footage will be available for analysis shortly after being captured and, through the application of advanced analytical techniques such as machine learning and AI, will greatly improve decision-making and response times in a wide variety of scenarios from change detection to object identification, from disaster response to infrastructure monitoring.



that delivers significant productivity increases to commercial construction projects. It uses autonomous laser scanners and photography to visually monitor a project, possibly on a daily basis, and then feeds this data to its proprietary deep learning algorithms. The algorithms then inspect the quality of installed work and measure installed quantities in real time. This enables project

managers to react to inefficiencies almost immediately and boost productivity by as much as fifty percent. The system is offered as a service from data capture through to analytics.

#### **3D MAPPING FROM MOBILE PHONES**

Bluesky has completed a research project backed by Innovate UK, to develop the use of mobile

&gt;

## TRIMBLE ANNOUNCES MX9



Trimble Geospatial has announced the release of the MX9 mobile mapping solution which combines a vehicle-mounted mobile lidar system, multi-camera imaging and field software for efficient, precise and high-volume data capture for a broad range of mobile mapping applications such as road surveys, topographic mapping, 3D modelling and asset management.

The MX9 captures dense point cloud data along with 360 degree immersive geo-referenced imagery using an industry-leading spherical camera, GNSS/INS technology and dual-head laser scanning sensors. Spatial data can be captured at highway speeds from inside the vehicle for safe operation in transportation corridors.

Complete integration with Trimble office software allows users to seamlessly process the acquired data and easily export their data for use with third-party software.

phones for capturing accurate 3D spatial information. The nine month investigation focused on the use of standard smart phone technology to capture and calibrate video footage, then convert it to 3D information. Accurate measurements of essential infrastructure, such as overhead power lines and other utility facilities, could then be extracted using specially developed algorithms and workflows. Following minor enhancements and additional trials, the mobile phone mapping tool, complete with data processing and hosting services, should launch in Q2 2018.

## TELEDYNE OPTECH ANNOUNCES ALTM GALAXY PRIME

Teledyne Optech has announced the ALTM Galaxy PRIME which builds on the PulseTRAK and SwathTRAK productivity features

## IN BRIEF

**YellowScan** has introduced the **Surveyor Ultra**, which integrates the Velodyne VLP-32C scanner and the Applanix APX-15 IMU. Its light weight (1.7kg) makes it easy to mount on any drone, including VTOLs. The Surveyor Ultra also has a turn-key system fitted for under vegetation 3D modelling, and fast data processing.

A new **Sentinel GNSS L1B RINEX** user product has been released for dual frequency GPS receivers on board the Sentinel-1, -2 and -3A satellites from the Copernicus Data Hub service. Users can access the data through the Open Hub web portal. It is expected to be used for scientific study the effect of non-conservative forces; ionosphere characterisation; gravity modelling and geodesy.

Texo Drone Survey and Inspection (Texo DSI) have become the first company in the UK to take ownership of the **Topcon Falcon 8+** UAV system. The multi-camera payload Falcon system uses best-in-class sensors to deliver aerial imaging, monitoring and mapping.

**Reviving Palmyra in Multiple Dimensions: Images, Ruins and Cultural Memory**, a book providing a visual reconstruction of Palmyra, a World Heritage Site situated in Syria, has been released. Using photogrammetry, digital imagery and 3D modelling; the book details how it was possible to recreate the lost monuments.

ProDroneWorx has announced that it has received industry recognition from the Chartered Institute of Architectural Technologists (CIAT) to run a Continuous Professional Development (CPD) course on '**Drone Technology within Architecture and Construction**'.

Spheron-VR AG, pioneers in HDR (High Dynamic Range) camera technology have sold 22 **SceneCam cameras to L&M Survey Services** Ltd along with SceneCenter 2.0 content management software, which will be used for dilapidation and inspection services, VR content capturing, 3D from photogrammetry, site familiarisation and documentation.

of the current Galaxy T1000 sensor platform by adding extended range performance for even greater collection efficiency, improved vegetation penetration, and increased low-reflectance target detection.

The Galaxy PRIME uses very high laser pulse repetition frequencies to generate data with high point density, even at high altitude and in variable terrain, without complex flight planning. Full 100% point density is maintained across the multi-pulse transition zones for true

data integrity, without having to create artificial filler points through interpolation.

The increase in range performance is as much as 30% over the Galaxy T1000. SwathTRAK technology dynamically adjusts the Galaxy's scan FOV in real time during data acquisition, enabling constant-width data swaths and constant point density, even in highly variable terrain, effectively enabling you to survey steep mountains as if they were flat. The result is far fewer flight lines to collect and process.

## PEOPLE

**HOBONA JOINS OGC**

Gobe Hobona MRICS has joined OGC as Director of Knowledge Management (DKM). He will be responsible

for planning and managing the workflow of candidate standards through their standardisation lifecycle by creating a knowledge sharing environment that allows insights and experiences from the OGC membership to feed into each candidate standard. Gobe is a Newcastle graduate and post graduate and former post doctoral researcher at the universities of Newcastle and Nottingham.

**MBE FOR COYO FOUNDER**

Alison Watson, chief executive of Class of Your Own (COYO), has been recognised in the New Year's Honours list with an

MBE for her services to education. Alison founded COYO to create and inspire the next generation of built environment professionals through project-based learning in schools and colleges.

**EARTHSENSE APPOINT THOMAS HALL AS MANAGING DIRECTOR**

EarthSense Systems has appointed



Thomas Hall as Managing Director. A remote sensing specialist with over 19 years' experience in the geospatial industry. He has a proven track record of developing emerging technology for wide market adoption and commercialisation.

Hall joins EarthSense from NM Group, specialists in the use of remotely sensed data for mapping of electricity operator assets, and part of Trimble, where he held the role of Sales Director, EMEA.

**MURPHY SURVEYS HIRE NEW HEAD OF MARKETING**

Rekha Voralia has joined Murphy Surveys as Head of Marketing. Rekha will

be responsible for the strategic direction and execution of the marketing communications plan across the company's key markets, including infrastructure, property, retail, utilities and construction. Rekha's previous career experience spans over 17 years and includes roles at mobile satellite giant Inmarsat and Leica Geosystems.

**NEW TOTAL STATION FROM TOPCON**

Topcon Positioning Group has announced the GM-100 total station which features dual-axis compensation and integrated Bluetooth technology with no external antenna necessary for connectivity with the controller. The instrument delivers high-end performance with a best-in-class accuracy of up to 6,000m, 1.5mm + 2ppm with a prism up to 1,000m and 2mm + 2ppm in reflectorless mode. Additional features include 50,000 points of internal memory and up to 32GB USB storage, as well as up to 28 hours of battery life and IP66 certification.



## EVENTS

**Got an event to list? Go to [www.geomatics-world.co.uk/events](http://www.geomatics-world.co.uk/events)**

**Oceanology**

13-14 March 2018  
*Excel, London, UK*

**7th Digital Earth Summit 2018**

17-19 April 2018  
*El Jadida, Morocco*

**GISRUK 2018**

17-20 April 2018  
*Leicester, UK*

**World Built Environment Forum Summit**

23-24 April 2018  
*London, UK*

**FIG Congress**

6-11 May 2018  
*Istanbul, Turkey*

**GEO Business 2018**

22-23 May 2018  
*London, UK*

**Survey Ireland Conference**

30 May 2018  
*Dunboyne, Ireland*

**SPAR 3D International 2018**

5-7 June 2018  
*California, USA*

**IGARSS**

23-27 July 2018  
*Valencia, Spain*

**RSPSoc with NCEO & CEOI**

4-8 September 2018  
*Venue TBC*

**Intergeo 2018**

16-18 October 2018  
*Frankfurt, Germany*

# New Standards, New Guidelines and New APC Pathways



James Kavanagh, Director of the RICS Land Group.

**Spring has sprung, and the final evening lectures have taken place in late Feb 2018. This has been an outstanding session with lectures on such diverse but interconnected subjects as machine learning and point clouds, satellite imagery, MapAction, Ordnance Survey, Survey4BIM and hydrographic surveying. The 2018/19 sessions will start in earnest in October**

**2018 – more details will be available online in due course. However, even if the lectures are done there is no letting up on the geospatial action within RICS.**

## UK GOVERNMENT GEOSPATIAL COMISSION

The Geospatial Commission, reported in GW in January/February, is an enormous step forward for our industry, and in so many ways; several of our geospatial industry colleagues, such as AGI [www.agi.org.uk/](http://www.agi.org.uk/), have come together to brief HM Government on what it needs to think about when developing the strategic remit of the commission. The Government Science and Engineering (GSE) profession has also just announced the appointment of a new cross-government Head of Geography for the profession, David Wood [www.gov.uk/government/news/geography-skills-across-government-recognised-by-new-role](http://www.gov.uk/government/news/geography-skills-across-government-recognised-by-new-role). This is a crucial role which brings geographic skillsets to the heart of Government and should have a big influence on the new geospatial commission. RICS will be working closely with our industry colleagues to ensure that the important contribution of our profession to the economy and future economic development is recognised. More on this as it develops.

Which brings me onto GeoBusiness 2018 held between 22-23 May [www.geobusinessshow.com](http://www.geobusinessshow.com) – amazingly GeoBusiness is now in its 5th year and goes from strength to strength. The exhibition is already nearly sold out, the hands-on industry workshops are loaded and the associated meetings are being organised. The fabled ‘Ale Trail’ returns as does the legendary ‘Gala Dinner’ which is being held in the mighty Emirates Stadium. The conference will see

an emphasis on the Geospatial Commission and on the Geospatial issues at the heart of the 4th industrial revolution <https://1spatial.com/news/2018/02/blog-geospatial-fourth-industrial-revolution/>

## UAV STANDARDS AND BSI

Our friends at BSI have been exceptionally active of late and have now turned their standards setting eye upon the rapidly evolving sector of UAV usage. A new drone major group has been set up (with a launch in the House of Lords Feb 2018) and online resources <https://standardsdevelopment.bsigroup.com/committees/50259034> - this group will probably be more focussed on CCA regulations and H&S issues for now, but BSI is the direct link the CEN (EU standards) and ISO (global standards). RICS has made sure that it will be represented on this group and is looking to include UAV issues within a new 6th edition of ‘Vertical Aerial Photography and Derived Digital Imagery’ guidance note during 2018/19.

## MONITORING AND INSTRUMENTATION GUIDE NOW AVAILABLE

CICES, TSA and RICS have been working collaboratively with major organisations such as Network Rail, Costain, HS2 and others on the production of a new ‘monitoring/instrumentation’ client guide and full best practice guidance note. [www.rics.org/uk/news/news-insight/comment/rics-collaborates-with-geospatial-industry-partners-on-new-monitoring-and-instrumentation-client-guides/](http://www.rics.org/uk/news/news-insight/comment/rics-collaborates-with-geospatial-industry-partners-on-new-monitoring-and-instrumentation-client-guides/)

## NEW APC PATHWAYS

RICS Geo has been working hard to review and update the geomatics APC pathway. Updates include competencies on BIM, Big Data, Smart Cities amongst others, and the core chartered land surveyor competency ‘Surveying & Mapping’ has been completely rebuilt and updated. [www.rics.org/uk/apc/pathway-guides/land-pathway-guides/geomatics/](http://www.rics.org/uk/apc/pathway-guides/land-pathway-guides/geomatics/). The new pathways will go ‘live’ during 2018. Many of you will also have noted that the popular AssocRICS pathway has changed name to ‘Geospatial Surveying’ and there is a growing need to also change the APC pathway name to ‘Geospatial Surveying’ to better reflect global and national reality. Geomatics, as a term,

has in many ways had its day. If any of you have any views on this issue please do let me know [jkavanagh@rics.org](mailto:jkavanagh@rics.org)

Another major development is the 2018 launch of Land Pathway, a combined pathway with core aspects from geomatics, mapping, planning & development, rural land management, environment, valuation and minerals. This broad-based pathway is already proving popular with multi-disciplinary organisations and global bodies. This is a key strategic output of the RICS Land group and helps open RICS membership to the entire geography sector.

Another big strategic output from the land group is the International Land Measurement Standards (ILMS). ILMS is a high level, principles based, land transfer standard that seeks to provide various users with a robust methodology for gathering the necessary land parcel data to enable transfer, acquisition, taxation and/or compensation. One element (of the 7) is, of course, parcel description (boundaries). ILMS will be presented at the World Bank Land Conference in March 2018 and at FIG in Istanbul, May 2018.

RICS is gearing up for FIG Congress in Istanbul and a strong delegation will attend and present on a wide variety of topics. RICS will put forward two commission chairs (9, 10) and Dr Diane Dumashie FRICS will stand for another 4 year term as vice-president. FIG Istanbul will be the global geospatial event of the year and we are more than confident that the Turkish surveyors (as led by Dr Orhan Ercan) will put on a wonderful event in the 'Queen of Cities'.

#### **RICS 150TH**

RICS is celebrating its 150th anniversary during 2018 and a variety of events are planned. RICS HQ Westminster is hosting a yearlong exhibition in the library (featuring some of the vast RICS historic collection of surveying instrumentation, maps and books) and an emphasis on future tech such as BIM, 3D modelling, UAVs and VR. A wonderful new video can be viewed at [www.youtube.com/watch?v=Adr1kaKFpF4](https://www.youtube.com/watch?v=Adr1kaKFpF4). If you get a chance, make sure to visit the permanent exhibition or indeed the

travelling exhibition which will be winding its way around the UK and global regions during 2018.

#### **SCSI ANNUAL DINNER 2018**

The Irish Society's Annual Dinner 2018 took place in early February at the Clayton Hotel, Burlington Road with 1,348 guests in attendance. Of course, every Dubliner knows this hotel as the 'Burlo' – a recent rebrand has had no effect on the colloquial use of that term. This was a wonderful event with Colin Bray, President of SCSI, opening proceedings with a very well received address. Colin is the first chartered land surveyor to hold this position and is CEO of Ordnance Survey Ireland. Ryder Cup captain and Irish golfing hero Paul McGinley gave the after-dinner speech and the bars of Burlo did brisk business into the early hours. Geospatial surveying is doing very well in Ireland with a growing economy, increasing student numbers and the revival of the Survey Ireland event (30 May 2018 Dublin). <https://scsi.blog/2018/02/07/scsi-annual-dinner-2018/>

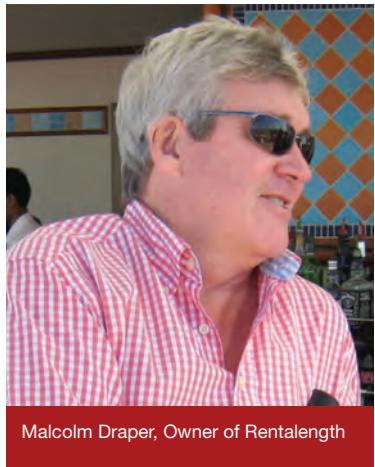
#### **WORLD SURVEYORS DAY 2018**

CLGE (EU licensed surveyors body), NSPS (USA), FIG and RICS have come together (along with the support of Leica) to launch a global Surveyors day (21 March). Several world regions have a surveyor's day (Europe & USA) for example but this is the first time it has gone truly global. The event will be held in conjunction with the World Bank Land Conference and will take the format of roundtable discussions followed by a drinks reception - another great way to raise the profile of our global profession.



Aine Myler  
(CEO SCSI),  
Paul McGinley  
and Colin Bray  
(President SCSI).

## Silken Maps and Bagnold's Sun Compass



Malcolm Draper, Owner of Rentalength

**We hope no readers were hurt by the collapse of Carillion, whose story began centuries ago with the founding of the Office of Works as part of the Royal Household in 1378.**

Through many guises it became the Ministry of Works in 1940 then in 1972 the Property Services Agency. It continued until 1993 when it was sold to Tarmac (which traces its origins to 1903) for the princely sum of £1 [source: Wikipedia]. Mowlem, Alfred McAlpine and others joined the party before the collapse.

With tales of subcontractors and suppliers waiting up to four months to be paid, Undercurrents can only repeat the early advice he received from his Dad, "Remember, until it's paid for it's only a gift!" We sympathise with those who've lost jobs or find that once again they are working for a new employer without having moved or applied for a position. We recall the words of the Roman novelist Gaius Petronius Arbiter: "We trained hard... but it seemed that every time we were beginning to form up into teams we would be reorganised. I was to learn later in life that we tend to meet any new situation by reorganising; and a wonderful method it can be for creating the illusion of progress while producing confusion, inefficiency, and demoralisation."

Bagnold's sun compass © IWM (FEQ 415)



### GEOMATICS

Undercurrents is interested to see the question has arisen again of how we surveyors name ourselves. Brian Coutts' article in the November/December issue of GW on "The Name Game – again" argued that Geomatics has outlived its usefulness and should be replaced by Geospatial Surveyor. For many of us, the G-word

has never sat comfortably as a substitute for land and engineering surveying. Academics (who argued for the change) and younger generations tend to use the word, if not with enthusiasm, there remains a core of us oldies who won't use it. The problem lies in the lack of marketing of the word. It might have just gained traction if the RICS had backed it with a massive campaign to our clients explaining what it meant.

### THRILL OF THE UNKNOWN

Undercurrents was lucky enough to attend Stephen Bagnold's lecture at the RGS on his father Ralph Alger Bagnold, "a private and modest man", yet whose exploration and surveying of the Western Desert in the 1930s led to him forming the Long Range Desert Group. Stephen's account of his father's exploits in the robust Model T Ford in the desert and the modifications, including a condensing system for the radiator (now seen on all cars), was fascinating. For navigation Bagnold developed the sun compass. The navigator sat beside the driver constantly checking his watch, the speedometer and the sun compass, which comprised a 360° dial that rotated around the shadow cast by a gnomon or pin. Having worked out where their journey began that day by astro fixes taken overnight, a bearing was set in line with the shadow cast by the gnomon. Every few miles the dial was reset to align with the shadow. To get a fuller appreciation of how this works go to YouTube and look up Bill North and the Bagnold Sun Compass. Amazingly, they were still using this method in the 1991 Gulf War when GPS sets were in short supply.

Bagnold also came to fame as a researcher into the movement and fluidity of sands. His expertise was sought by NASA for the early Mars missions and he shared a paper with the great scientist Carl Sagan. Overarching Bagnold's life was the thrill of all exploration and the unknown. His enquiring mind was guided by the view that "Chance is but a name for Law not recognised."

### SILK MAPS AGAIN

When we reported in the last column Malcolm Anderson's story of silk maps hidden in Monopoly sets, we hadn't received the RGS's schedule of lectures for 2018. Undercurrents was therefore delighted to hear Dr Barbara Bond, author of *Great Escapes: The story of MI9's Second World War escape and evasion*

maps. From Dr Bond we learnt about the production of thousands of maps printed on silk produced for British prisoners to encourage escape. The maps were hidden in things like games, playing cards and gramophone records sent to the prisoners to help while in captivity.

One slide she showed had more than a sense of wry irony. The so-called "Smash Hits" programme hid maps sandwiched within gramophone records; the sample sleeve on the slide listed Beethoven under the baton of Toscanini. To get the map the prisoners would doubtless have enjoyed smashing their way into a recording of German music conducted by an Italian!

Several readers have been in touch since then on this topic. Bob Owen had already heard Dr Bond's lecture at the British Library. He mentions that the ever-efficient German authorities sent back receipts acknowledging safe delivery of the parcels, whilst the Italians were so disorganised there was never any evidence that anything got through. Bob adds, "Thanks for keeping us all amused and informed with your column."

Appreciated Bob.

Jim Woodhams writes to say he always turns straight to Undercurrents: "My source of all Geomatics gossip." Jim shared some photos of the silk map he inherited from his late father, Ken Woodhams. "This was his escape map that he carried with him through mid 1943 until the end of the war, when he was on Naval operations in the Mediterranean. During this time, he was second officer and subsequently commanding officer of MTB 309, operating out of Alexandria and Malta, often on covert missions in enemy waters."

"I remember him telling me he carried the map with him at all times. It's a bit faded on one side, but otherwise still in remarkably good condition... and very detailed too as the close-up of Greece shows. Maybe we could have a more detailed article in GW about these maps? I for one would be interested!"

More generally, Ian K Bleasdale writes: "I'm a very long-time retired MRICS but they keep sending me the magazines though much of it seems gobbledegook to me. All the abbreviations, UAV, RIEGL, IAFSM, FIG, TSA, and that's just the first page! Mind, I was brought up on abbreviations; rwp, dpc, ges(pipe), sws, TP, OS, BM etc. So keep up the good work and then there will

continue to be at least one page in Geomatics World I can (faintly) grasp. By the way, my spell-checker doesn't recognise Geomatics!"

#### MISCELLANY

We rather enjoy palindromes, sequences that read the same backwards or forwards. Here's a really weird one: multiply 111,111,111 by 111,111,111. What do you get? Incredibly 12,345,678,987,654,321. Weird ay?

Undercurrents always enjoys understatement, a great British trait. Others around the world are catching on. Following a plane that skidded off the runway in Turkey and ended up perilously perched on a sloping cliff and nearly on the beach below, a company spokesperson explained that the aircraft had, "had a runway excursion incident". Hmm, quite an excursion!

Researchers into the nose and sneezing have identified a specific syndrome for those who sneeze repeatedly: "Autosomal cholinergic helio-ophthalmologic outburst". Naturally abbreviated to... ACHOO!

*Part of Jim Woodhams' father's silk map of Greece.*



Undercurrents is a joint column by Malcolm Draper and former GW editor Stephen Booth. Do feel free to drop us a line with any (vaguely!) relevant surveying stories to: [rentamalc@aol.com](mailto:rentamalc@aol.com). For the sake of a good story we are always prepared to change names, details etc to protect the innocent as well as the guilty.

# Space Enabled Innovation in Cities - Advances in Earth Observation

**The Earth Observation (EO) industry is going through a time of radical and exciting transformation. No longer exclusively the realm of government and big industry, space is becoming increasingly accessible to the mass market. Exponential evolution of technology, coupled with reduced cost of manufacture and launch, has triggered a renaissance, which is capturing the imagination of the markets.**

Sensor technology can deliver extremely high-resolution imagery, Synthetic Aperture Radar (SAR), and video on a satellite that is as small as 400kg. New operating concepts and business models are also removing barriers to entry. This has led to an influx of private companies into the sector, demonstrating widespread disruption. Entrepreneurship in response to data needs of the community is stimulating the market through a new wave of space-based applications. For cities, space enabled services are key to realising industrial revolution, where the notion of digital twin and real-time data analytics is driving market growth.

## TRENDS IN EARTH OBSERVATION

The most significant trends in the space sector may be characterised by advancements in upstream technology or improvements in downstream service provision. Upstream innovations are being driven by miniaturisation of electronics, improved optics systems, power capture/storage, and improved communications systems. Advances in EO capability are being observed in spatial resolution, temporal resolution, radiometric resolution, real-time data access and greater storage

capacity. These developments will enable greater ability to carry out situational awareness and deliver advanced analytics capability.

Increased availability of this technology at significantly reduced cost has enabled a movement towards the deployment of distributed small satellite systems. The traditional model of satellite manufacture has been broken by leveraging a rapid iterative development approach, which allows delivery at a fraction of the cost and time of legacy satellite systems. High temporal resolution satellite imagery provided by these constellations will reveal patterns in, and allow monitoring of, highly changeable environments, moving closer to a reality of persistent surveillance. Furthermore, greater demand for near real-time applications has led to the development of geostationary data relay satellites, enabling EO platforms in low Earth orbits to have almost continual communication with a control ground station. With satellites producing increasing amounts of data, more work is also being done to enable on-board processing. These advances will facilitate near real-time transfer of data, empowering users to make

smarter and quicker decisions. One of the most exciting recent developments is the offer of video from space. This type of technology will continue to become more prolific allowing true situational awareness over an area of interest.

A significant development in terms of realising the value of EO data for economic development is European investment into the Copernicus programme. The programme will deliver 25 petabytes of open EO data over the next five years, leading to generation of an estimated US\$35bn market, and tens of thousands of new jobs by 2030, from services and applications that exploit the data in new value chains. The Copernicus satellites, termed Sentinels, carry a range of technologies such as radar and multi-spectral imaging instruments for land, ocean and atmospheric monitoring.

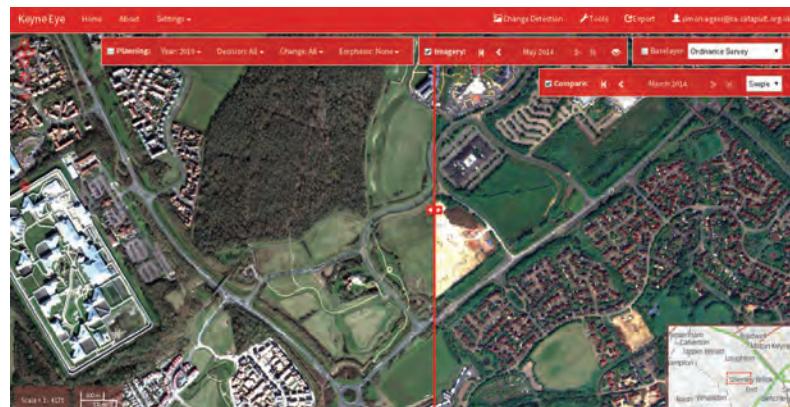
Downstream innovations refer to developments in the latter stages of the industrial process, notably delivery of value added services. Currently, one of the most significant disrupting technologies is Artificial Intelligence. With dense time series of high resolution satellite imagery now available on the cloud, we have arrived at a juncture in the space industry where it is possible to exploit computer vision technology. This type of technology will facilitate the recognition of important dynamic features in a fully automated manner. To realise such techniques and manage the unprecedented volumes of data required to undertake

them it is necessary to exploit new IT infrastructures, such as high performance computing and graphic processing units.

Traditionally one of the soft blockers to enabling downstream exploitation of satellite data has been the commercial models surrounding data provision. Current commercial data provider business models are inflexible and tend to be based on “pay-per-image”, irrespective of how much of the image is of use to the customer. This, together with the relatively inflated cost of imagery, has led to a scenario where market needs are not being met and there is an underutilisation of available EO data. Diversification of these business models is becoming increasingly common, allowing a more customer oriented experience, with a decrease in emphasis on minimum area orders and the development of “pay-per-pixel” type models. This allows flow through of similar terms from the service provider to the customer where Software as a Service (SaaS) models are increasingly becoming the norm.

## BIG DATA IN CITIES

A thirst to understand and manage our environment through the application of knowledge is causing a paradigm shift to occur in our cities, where the adoption and use of Big Data is being harnessed to improve quality of life. Critical resources will need to be monitored and optimised to reduce costs, and decisions will need to be made to accommodate city inhabitants. According to a recent study, the expected global value of products and services for this market will be US\$1.5 trillion by 2020. Cities are experiencing unprecedented access to information, new emerging technologies and the convergence of information and infrastructure networks. EO provides an unparalleled opportunity for providing non-invasive, high



*Local Council Planning Management Data © Includes copyrighted material of DigitalGlobe, Inc., All Rights Reserved (2014), Contains OS data © Crown copyright and database right (2014), Image © Satellite Applications Catapult.*

resolution, wide area surveillance across a city. Advancements in EO technology alongside wider transformation in the space sector converge perfectly with this new revolution occurring in cities.

### CASE STUDY 1 – LOCAL COUNCIL PLANNING MANAGEMENT

The challenge of supporting sustainable growth without exceeding infrastructure capacity in Milton Keynes, whilst meeting key carbon reduction targets, is a major one. Historically, the planning management was done manually and involved issuing planning permits. To ensure adherence to the permit, planning officers were sent to physically inspect the properties listed in the database and verify that changes were in accordance with those approved within the planning permit. The entire process was inefficient and costly. The Satellite Applications Catapult has collaborated with Milton Keynes Council to leverage space technology in support of conducting change detection to the built environment over time.

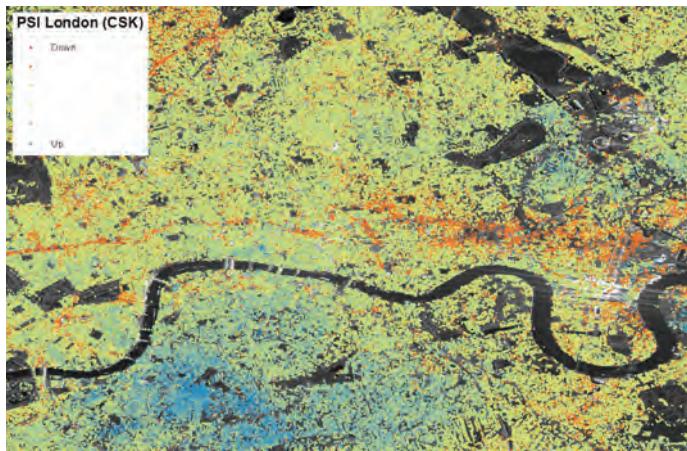
By utilising very high resolution multispectral satellite imagery (8 spectral bands, 30cm spatial resolution) it is possible to track change and easily identify where

any illegal activity may be occurring. This is done by characterising the land use according to several parameters such as geometry, colour, height and texture. These characteristics are extracted from the imagery and classified. Images captured at different dates are then compared to highlight and characterise discrepancy. Updates are provided quarterly through an intuitive dashboard that allows users to interrogate the data and make informed decisions, conducting analysis in accordance with the approved planning permits. Planning officers can simply view change information at their desks with substantial time and cost saving to the council. This represents the type of change that will be required to address the growing challenge facing UK cities around economic development and sustainability.

### CASE STUDY 2 – ASSET MONITORING

Engineers are not able to constantly monitor bridges and other structures in person, so the ability to remotely monitor assets and detect unexpected movements or sinking to a millimetre level could potentially highlight problems before they become disasters. The Satellite Applications Catapult, in collaboration with University

&gt;



*Ground movement in London 2011 - 2016, Data © ASI, 2011-2016, Image © Satellite Applications Catapult, 2018.*



*Identification of solar roof suitability, Data © Airbus DS / Spot Image 2017, Contains OS data © Crown copyright and database right (2017), Image © energeo ltd.*

of Cambridge, University of Leeds, and InSpace Missions, are working to demonstrate how the use of Interferometric Synthetic Aperture Radar (InSAR) (X-band, 3m spatial resolution) and IoT technology can provide a reliable and sustainable solution for improving and lowering asset management costs. When features on the ground move, the distance between the sensor on the satellite and the Earth's surface changes, thereby producing a corresponding change in measured signal phase. The changes in measured phase that occur between repeat passes of the satellite are used to quantify millimetre scale ground movements. In the future, the Building Information Modelling (BIM)

community will be able to make use of bridge monitoring services that exploit this technology and use BIM software to help improve visualisation techniques and develop new asset management solutions.

### CASE STUDY 3 – COMMUNITY ACTION PLATFORM FOR ENERGY (CAPE)

CAPE works with communities and businesses to provide a new way to manage energy. CAPE members are invited to give their ideas for schemes such as solar panels, insulation, or electric cars, and the best suppliers bid to deliver the schemes. By buying as a community group, prices are reduced and quality of service improved. The platform gives local companies the opportunity to become suppliers which also creates jobs in the local area. This project is a collaboration between SmartKlub, Community Action MK, Open University, Tech Mahindra, Satellite Applications Catapult and Milton Keynes Council.

The platform leverages analysis of satellite imagery (4 spectral bands, 1.5m spatial resolution) to derive information products, identifying the potential for new solar energy projects (thermal emissivity and roof pitch/orientation) in and around the city, and model the cost

and potential for any such new renewable energy capacity to link to the electricity grid. The results of this analysis, enriched by integration with other spatial and non-spatial data, is also used to highlight where the greatest potential exists to implement energy saving schemes, such as the installation of loft insulation or Ground Source Heat Pumps (size and accessibility of garden) at a property-by-property level across the city.

### CONCLUSION

The EO sector is rapidly coming of age, moving away from the cottage industry it once was and becoming firmly embedded as a mainstream technology across numerous market verticals. This is largely enabled through strong collaboration with other tech sectors, which is adding significant value across a range of commercial opportunities. Space based applications have been enabled in areas such as air pollution, ground movement, renewable energy potential, heat vulnerability indexing, ecosystem services, flood management, housing, and development and infrastructure monitoring. End users at all stages across the various market areas are getting excited about EO, and the mass market has never been closer to the data, providing new sources of intelligence to give a competitive advantage.

#### ABOUT THE AUTHOR

Dan Wicks is a senior Earth observation specialist at the Satellite Applications Catapult, a not-for-profit research organisation focused on promoting the commercialisation and advancement of the satellite applications industry. He is responsible for leading a range of projects in support of the exploitation of data from Earth observation satellites and is experienced in developing new geo-enabled commercial applications across a range of market sectors. He is also a fellow of the Royal Geographical Society.



# Collecting and Managing Big Data Brings Responsibilities

**The mantra that “data is king” was instilled into me when I was a relatively new (and young) surveyor. Nowadays data is still a prime focus, but its volume is such that “big data” is now considered normal and is sometimes masking the importance of the characteristics, continuity and integrity of the data itself. Data from remote platforms and space featured in this issue is a prime example of increasing data volumes.**

Data is now considered to be a valuable key commodity of the world's largest traded companies. It is said to be replacing oil as the major commodity for new business innovation and new enterprises. The comparison to oil is interesting for us who deal with geospatial data and provide geomatics expertise to that industry. Oil is generally a single use item and operates in a steady and perhaps even slow way. Data on the other hand is fast evolving and re-useable and of potentially unlimited supply. In addition, data is controlled by a much broader group than oil which in some senses means the crowd control it. Geomatics is an enabler for and the engine of, oh so many, other spatial data based uses and location applications. We are in a period where the data is gaining ever increasing numbers and types of users who may ultimately determine the future use and importance of our spatial data.

## REGULATION IS IMPORTANT!

Whilst we innovate and develop uses for the increasing amount of data we collect, technology is enabling us to gain greater access and potentially greater control. However with this comes a security issue. Data privacy is now a major concern for many and the EU is introducing the General Data Protection Regulation (GDPR), [www.eugdpr.org](http://www.eugdpr.org). The Regulation aims to improve data privacy and protection by extending jurisdiction of the GDPR to all companies processing the personal data of subjects residing in the Union, regardless of the company's location. The GDPR has introduced penalties that can be as much as 4% of a company's global annual turnover and also there are strengthened conditions relating to consent. It is important to understand that not all geospatial data is personal data and GDPR is very relevant to the geomatics profession so it's important to correctly identify such data. Data that is personalised or has certain attributes included with it will be subject to the new regulations. So maintaining anonymity with such data may not be too straightforward, but at least we, as

spatial data professionals, understand the location and position component that accounts for over 75% of all information and for many of our clients nearer 90%.

A data breach must be reported immediately to avoid penalties, however the potential danger of a breach is now not only a significant fine but potentially a much more devastating debilitation of your organisation, company or other prime IT network. Take last year's NotPeyta cyber attacks on various global businesses and organisations. This was virtually an extinction level event for several very large multinationals.

Those of us who are collecting, processing and delivering geospatial data must be under no illusion that this new data rich environment we enjoy has its darker side.

Spatial integrity must be matched with data integrity which of course is nothing new for us, but its context within big data and data mining means we can provide specialist insight and services across the developing and to date, not fully regulated, data domains.



Gordon Johnston, Chair of the RICS Geomatics Professional Group. Gordon welcomes your comments and thoughts so please email to the following address [geochair.rics@gmail.com](mailto:geochair.rics@gmail.com)

## GEOBUSINESS & FIG

This May the FIG Congress will be held in Istanbul with the theme “Embracing our Smart World Where Continents Connect”. The other key event in May is GeoBusiness 2018 which this year includes a new format seminar with thought provoking sessions and presentations that illustrate the impact geospatial technologies and innovative solutions are having on our global environment. Both these events aim to promote and include the younger professionals and students who we hope will come to represent us in the future and enable our profession to continue to develop new technologies, techniques and to sustain the “data is king” mantra.

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# Geomatics World Talks to Steven Ramage, Head of External Relations, GEO

**Steven Ramage has spent most of his career in the geospatial sector working for Navteq (now HERE), 1Spatial, Open Geospatial Consortium, Ordnance Survey and what3words; with a short spell running Ramage Consulting and advising the World Bank and UN-GGIM. He has also been involved in location strategy, policy and innovation at various points in his career and worked extensively overseas.**

**GEOMATICS WORLD: PLEASE GIVE OUR READERS SOME INFORMATION ON WHY YOU WERE ATTRACTED TO WORK IN GEO**

Steven Ramage: I joined the Group on Earth Observations (GEO) in 2016 to raise awareness and share

States) and partners, known as Participating Organisations, on our engagement priorities, as well as to lead our strategic communications. I've also been leading our commercial sector engagement with support from the GEO Executive Committee. The role helps me use

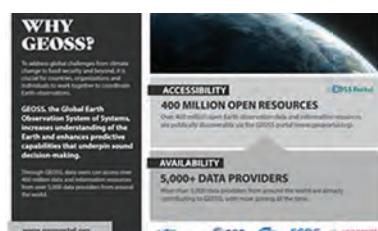
***There are now more than 400 million open Earth observation data and information resources in the GEOSS Platform...***

information about the wealth of freely available resources in the GEOSS Platform, as well as the depth and breadth of the GEO Work Programme. Essentially, I work to explain the usefulness and value of open Earth observations data and information and the impact of GEO. My job is working with GEO members (over 100 UN Member

my experience, knowledge, skills and international network of industry professionals to further GEO's mission.

**GW: WHAT IS THE MISSION OF GEO AND WHAT ARE ITS MAIN ACTIVITIES?**

SR: GEO is an intergovernmental, global partnership connecting government institutions, academic and research institutions and the private sector. The goal is to work with national governments, as UN Member States, to understand the value, usefulness and applications of Earth observations for research, policy and decision making. This means that we are coordinating a large number of activities relating to



GEOSS explained.

Earth observations that help identify gaps and reduce duplication in the areas of sustainable development and sound environmental management.

The organising principle of GEO was, and continues to be, a series of Societal Benefit Areas (SBAs), ranging from agriculture and biodiversity to disasters, urban infrastructure and water resources management. Today, our engagement priorities are linked to international policy, namely the Paris Agreement for Climate, the Sendai Framework for Disaster Risk Reduction and the United Nations 2030 Agenda for Sustainable Development. For each of these priority areas, the GEO community is working collaboratively to determine how and where Earth observations add value.

For example, with the Sustainable Development Goals (SDGs), there is a GEO initiative called EO4SDG (Earth Observations in the service of the Sustainable Development Goals). EO4SDG is led by the USA (NASA) with extensive support from the European Space Agency (ESA), INEGI in Mexico and the Japanese Space Agency (JAXA), and is working closely with the UN Statistics Commission and the UN Committee of Experts on Global Geospatial Information (UN-GGIM). The activities of EO4SDG are focusing on the use of Earth observations integrated with national statistics to help monitor, report and deliver the SDGs. There

are similar global, collaborative activities in the areas of climate and disasters.

Together, the GEO community is creating a Global Earth Observation System of Systems (GEOSS) to better integrate observing systems and share data by connecting existing infrastructures using a suite of common standards. There are now more than 400 million open Earth observation data and information resources in the GEOSS Platform from more than 5000 data providers. These resources can be freely accessed from the GEO website, the GEOSS portal or using the GEO application programming interfaces for machine-to-machine communication.

Ministers of the GEO member governments meet periodically to provide the political mandate and overall strategic direction for GEO. The Mexico City Ministerial Declaration from the GEO Ministerial Meeting in 2015 saw world leaders commit to support open Earth observation data for future years. The next Ministerial meeting is in 2019 and we understand the UK may be interested in hosting this summit.

#### **GW: IS THERE ONE DRIVING PRINCIPLE BEHIND GEO?**

SR: Broad availability of Earth observations through open access mechanisms and data sharing mandates included in national government policy.

#### **GW: HOW DOES THE UK INTERACT WITH GEO?**

SR: The UK has been involved in GEO for many years, particularly through the Work Programme. Each country involved in GEO typically has a national GEO activity, and UK GEO is led by Defra, who sit on the GEO Executive Committee. One of the broadest national representations at the GEO Plenary last year in Washington DC

was from the UK. More than ten organisations were part of the UK delegation, including Nottingham University, the Office for National Statistics, the Met Office and Ordnance Survey. There's a great write up from Iain Williams, Defra's Deputy Chief Scientific Adviser, that provides some additional input to this question. To read more, visit the post on GEO's Blog (4 December 2017, Earth Observations: Global Perspectives from the UK).

#### **GW: THE UNITED NATIONS IS INVOLVED IN COORDINATING EARTH OBSERVATION ACTIVITIES THROUGH GGIM AND UNOOSA. HOW DOES GEO WORK WITH THESE ORGANISATIONS?**

SR: Earth observations are used across the entire United Nations system, including the UN Development Programme (UNDP), UN Environment, UNICEF, UN-

been around UNISPACE+50, where UNOOSA plans to celebrate the 50th anniversary of the first United Nations Conference on the Exploration and Peaceful Uses of Outer Space, from 20-21 June 2018 in Vienna, Austria. UNOOSA is also a Participating Organisation in GEO and a key collaborator.

#### **GW: GEO HAS IDENTIFIED A NUMBER OF SOCIETAL BENEFIT AREAS. HOW DO THESE INTERACT WITH THE UN SUSTAINABLE DEVELOPMENT GOALS?**

SR: The SBAs have helped to shape the GEO Work Programme. Many of the SBAs and related activities in the Work Programme align with the SDGs, for example our GEOGLAM Flagship initiative is focused on global agriculture monitoring and directly tied to food security and SDG2 Zero Hunger. Other areas include urban resilience, and through EO4SDG we

#### ***... it's still all about collaboration and human interaction.***

Habitat, UNOSAT and others. I think the important role that UN-GGIM and UNOOSA play is related to policy development and capacity building. There is a longstanding partnership here where both organisations are recognised observers in their respective communities. UN-GGIM is the global geospatial policy leader and conduit for GEO to work with national statistical offices, in particular the work that GEO does to support the Working Group on Geospatial Information (WGGI) through the Inter Agency Expert Group (IAEG) on SDG Indicators. Conversely, GEO provides input to the UN-GGIM community on activities relating to Earth observations.

GEO and UNOOSA have also worked together for many years. The most recent collaboration between both organisations has

have been working with the national statistical agency of Columbia (DANE) on SDG11 Sustainable Cities and Communities working with our partners at the Global Partnership for Sustainable Development Data (GPSDD), NASA and the World Bank to look at land use, land change and population growth. Also for water resources management, we have been working with the Google Earth Engine team, the Joint Research Centre of the European Commission and UN Environment on the spatial extent of water for SDG6 Clean Water and Sanitation.

#### **GW: DO COMMERCIAL ORGANISATIONS HAVE A ROLE IN GEO?**

SR: Yes, absolutely. The commercial sector is already engaged in the GEO Work Programme, and we use technology and broker data catalogs >



Steven Ramage (left), Head of External Relations, GEO.

in the GEOSS Platform from Carto, Digital Globe, Esri and Mapbox. Esri in particular has made a significant investment in integrating ArcGIS Online (AGOL) with the GEOSS Platform, meaning that anyone can access the Earth observation resources via their AGOL account or the GEOSS Portal. We actively encourage Small to Medium Sized Enterprises (SMEs) to use the open data that is freely available and hopefully build greater insights or new business opportunities from using the data. During the GEO Plenary in Washington DC last October we invited a number of industry executives to meet with the GEO Executive Committee, and we plan to do the same again at other meetings. This provides

### **A key change in our community will be the move from a data-centric approach to a user-centric approach.**

an opportunity for leaders from the public and private sectors to share ideas and information, and collaborate with each other.

#### **GW: WHAT SERVICES DOES GEO OFFER THE USERS OF EO DATA?**

SR: I work at the GEO Secretariat in Geneva, Switzerland and we are essentially coordinating all the activities of the global GEO community (Members, Participating Organisations, Observers, the GEO Plenary, the Executive Committee

and the GEO Programme Board). It is this global community that provides a host of services, whether that is through our Participating Organisations or via our commercial sector engagements. The big opportunity for GEO is to bring in the emerging companies working on data analytics tools and services and engage them more broadly in the Earth observations community.

#### **GW: PLEASE GIVE SOME EXAMPLES OF THE PROJECTS WHICH GEO PROMOTES, PARTICULARLY IF THERE ARE ANY RELATING TO THE UK?**

SR: As mentioned earlier, disaster risk reduction is one of the GEO engagement priorities and the UK has now appointed James Norris (from Ordnance Survey) on secondment to the GEO Secretariat. He will work with the GEO community on aligning our activities across the entire GEO Work Programme. In particular, disaster resilience with UN-GGIM and UNISDR the Sendai Framework, GEO-DARMA and GSNI will be his areas of focus.

The UK is also working on data cubes, a concept pioneered in the GEO community by Digital Earth Australia as part of a AU\$50m

investment. A data cube is an analytical engine developed to routinely transform Earth observations into actionable information for users and decision makers. The Australian data cube has organised more than 30 years of open Landsat data across the entire Australian continent to deliver information products of use to decision makers; this approach is now being replicated around the world particularly with the work being done by GPSDD and the Committee on Earth Observation Satellites

(CEOS). GEO is advocating for regional data cubes, and ultimately a global data cube, which will put analysis-ready data into the hands of those who need it all over the world.

#### **GW: HOW DO YOU SEE THE FUTURE OF EARTH OBSERVATION GLOBALLY?**

SR: At GEO Week 2017, we laid out our plans for the next 10 years. A key change in our community will be the move from a data-centric approach to a user-centric approach. In practice, this means that our work will be more user-needs driven, and the products and services produced will be end-user ready. Getting actionable information into the hands of those making decisions that impact us all is an important mission, and one that the GEO community is working hard to achieve.

The rate of change in Earth observations is staggering and I can see a number of new private sector organisations really making an impact, including those from the UK. This is good because government structures and policy development cannot possibly keep up with the rate of change, so they can benefit from the tools, services and experience available from the private sector. I see a number of governments globally now starting to understand and really make use of Earth observations (I would say the UK is fairly advanced in this aspect) and the previous hype around many other technologies and approaches that can turbo charge Earth observations processing, analysis and application, such as machine learning, deep learning and Artificial Intelligence is now reality.

I probably sound like a broken record, but I believe it's still all about collaboration and human interaction. The technology must be fit for purpose or it will not be used, and over time we will figure out how to communicate the value of Earth observations for the benefit of humankind.

# The Survey Association Partners with SmartWater to Tackle Equipment Theft

**The Survey Association (TSA) has signed a three year agreement with SmartWater in response to an unprecedented rise in equipment theft. Figures from March 2017 to January 2018 indicate survey equipment worth an estimated £2.4 million was stolen from TSA members across the UK causing delays, raising concerns about personal safety and security and incurring additional costs. These thefts can now be reported through a dedicated Intelligence Portal launched by SmartWater Technology.**

Adam Bradley, President of TSA, said "TSA has been working to find the best way we can support our members, to prevent crime and to recover equipment. SmartWater has an established track record for detecting and deterring criminal activity and we would encourage all our members to provide date and location

details for every incident of equipment theft, both recent and historic, so their analysts can liaise with the police and assist with enquiries on behalf of TSA."

Detailed reports, statements, timelines, association charts and maps, produced by SmartWater analysts will shed further light on the pattern of criminal activity. The new initiative is sponsored by Leica Geosystems, Trimble and Topcon.

Information submitted through the portal will be used to compile monthly reports for TSA Members. The data will identify crime hotspots, emerging crime trends and possible links to current investigations. A risk rating will be issued each quarter, with advice for crime prevention to those likely to be a target. Non-TSA Members can also report their thefts through the portal. For further details and to submit information on a theft, email office@tsa-uk.org.uk

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# Robust Automatic 3D Point Cloud Registration and Object Detection

**This article presents a ground-breaking approach to generating survey data for a BIM process offered by the Vercator toolkit. Produced by a UCL spin-out company, Correvate, it touches on the robust automatic registration and smart object recognition technology that the company is developing for downstream analysis.**

In order to construct survey-grade 3D models of buildings, roads, railway stations, canals and other similar structures, the 3D environment must be fully recorded with accuracy. Following this, accurate measurements of the dimensions can be made on the recorded 3D datasets to enable 3D model extraction without having to return to the site and in significantly reduced times. The model may be compared to the original design and serves as a digital record of the asset at a given point in time. Laser scanning has become a powerful way of capturing 3D measured data about the built environment. However, the process of registering the point clouds produced from static terrestrial scanning to extract useful information is user-intensive and time-consuming.

## THE VERCATOR APPROACH

In the approach adopted by Vercator, vectors in overlapping scans are matched and brought into alignment, first to perform rotation alignment, and then translation alignment in the horizontal plane, followed by translation alignment in the vertical plane. In fact, such vectors are calculated and found at every point. Typically there are 10's of millions of natural targets in each scan compared to the 10's of artificial targets or natural targets marked by eye in other approaches, resulting in fewer misalignments. The advantage of the Vercator approach is that the process utilises natural features in the 3D environment as natural targets which are automatically recognised, their location and orientation determined, then represented by feature vectors. A detailed description of the method can be seen in the box out.

## PERFORMANCE

By representing features in the natural environment as vectors, then bringing these into alignment and treating them as natural targets, pairs of overlapping scans can be

quickly and reliably aligned. These vectors reduce the number of misalignments to otherwise similar features, resulting in a more reliable and robust method.

The proportion of scans aligning depends on the nature of the 3D scene being scanned, but in trials carried out with 6 datasets ranging from 16 to 129 internal and external building scans, between 87% and 100% of the scans automatically aligned with an accuracy of less than 5mm in under 4.5 hours.

Compared to the technique of using laser scanners and a number of artificial targets, the Vercator method aligns scans automatically, significantly reducing registration time. The time depends on the number of scans and the types of scans; the benefit increasing with the number of scans. So, for 251 scans of a building with corridors, a large hall and a multi-floor atrium with escalators, alignment can be achieved in 10 hours as opposed to 60 hours via conventional methods. Since Vercator is predominantly automatic, this represents an even greater saving in costly operator hours. The alignment accuracy of the Vercator method was within 3.2mm. This figure is within the laser scanner measurement accuracy of  $\pm 2\text{mm}$ , so is, at the very least, the state of the art to within the measurement error.

During trials, 105 scans of a complex network of rails, platforms and station buildings were aligned automatically by an experienced operator with the Vercator software in 10 hours as opposed

Type of Structure	No. of Scans	Conventional Alignment	Vercator Alignment	Time Saving
Offices, interior & exterior	251	60 hours	10 hours	83 %
Large building (reduced resolution)	192	40 hours	8 hours	80 %
Large building	130	20 hours	4 hours	80 %
Street scene, Central London	65	10 hours	1 ½ hours	85 %
Laboratories	32	4 hours	1 hour	75 %
Library interior	28	2 hours	45 mins	63 %
Concrete building core interior 1 floor	16	1 hour	20 mins	60 %

## DETAILS OF THE METHOD

Consider the natural features and targets to be small flat elemental areas, because many 3D environments being scanned have such features. Each flat element is represented by a vector direction, which is either normal or at right angles to each small flat plane, but its length is normalised to one. We can then draw these ‘surface normal vectors’ as small arrows starting at each point and pointing away from it, as shown in figure 1.



Figure 1: Surface normal vectors.

## ROTATIONAL ALIGNMENT

Now imagine that each vector is lifted away from where it is, but maintains its direction and is moved so that its tail lies at the origin of a new space. All of the surface normal vectors have the same length so their arrow tips will lie on the surface of a sphere, as shown in figure 2. A pattern is created on the surface of the sphere. For example, a wall will have many surface normal vectors, all of which will be represented on the surface of the sphere, roughly at the same place since the surface normals will be generally parallel. This is carried out for each overlapping scan giving the sphere its own pattern for each scan. Now if the scans have sufficient overlap the resulting patterns will have many similar features. So, by moving the origin of the sphere for one scan to coincide with the origin of the sphere for an adjacent overlapping scan, we nest two spheres inside one another. Then

we only have to rotate one sphere relative to the other until the two patterns match in order to obtain the angles we need to rotate one scan to bring it into alignment with the other scan. If the horizontal is known, it is only necessary to perform a rotation about a vertical axis until the two patterns match.

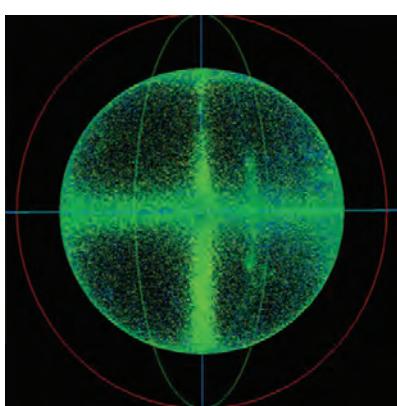


Figure 2: Vectors represented on the surface of a sphere.

## HORIZONTAL TRANSLATION ALIGNMENT

To determine how much horizontal movement the scans require, the point cloud scans are projected, collapsed or squashed onto the horizontal plane to form a 2D plan view, figure 3. When the points collapse onto the plane, vertical walls which have millions of points on them will collapse to form a line on the plane. This creates a point density image. These 2D plan view images have already been rotated to have the same angular rotational alignment, so all that is necessary is to slide the image for one scan over that of the adjacent scan, then to calculate the degree of match to find the position of best alignment. The degree of match calculation takes into account the density of points.



Figure 3: Horizontal alignment on the horizontal plane.

## VERTICAL TRANSLATION ALIGNMENT

To find the vertical shift or translation, the point clouds of the two scans are separately projected, collapsed or squashed onto a vertical rod, figure 4. Flat floors with millions of points on them collapse to very high densities of points on the rod, and similarly with flat ceilings. The point density pattern of one scan is slid over the point density pattern of the other scan to obtain the position of best match, which indicates how far one scan must be moved to bring it into alignment with the other scan. To ensure a flat horizontal floor in one scan aligns to a flat floor in the overlapping scan and not to a flat horizontal ceiling, the surface normal direction is retained in the process of collapse. Since all floor points have surface normal vectors pointing up and all ceiling points have surface normal vectors pointing down, the floor can be distinguished from the ceiling and only matched to points with surface normal vectors pointing in the same direction.

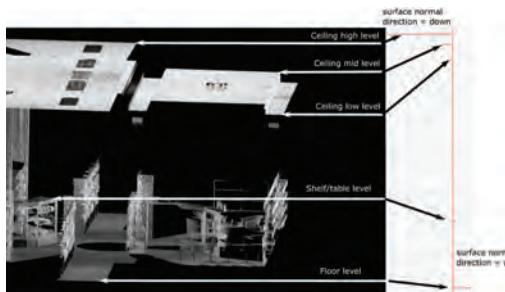


Figure 4: Vertical alignment on a rod.

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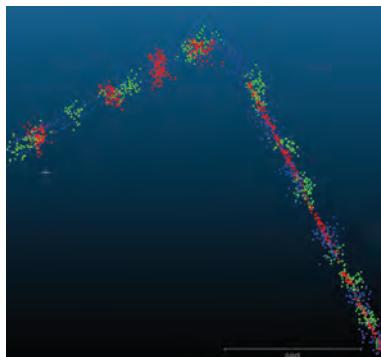


Figure 5: Alignment accuracy of 3 scans.



Figure 6: Chair recognition from point clouds using deep learning.

to 2 operators over 10 days, the latter encountering considerable challenges using current semi-automated techniques.

Potential savings are shown in the table on page 24 with typical performance indicators for conventional alignment methods, mostly using artificial targets, compared with those of the Vercator Toolkit.

Additional benefits include:

- Reduced preparation: easy to set up without the need for targets
- Automated: registering of overlapping data is automatic
- Robust: targets are eliminated minimising mis-identification
- Quality: equals current industry workflow standards and reports

### AUTOMATIC OBJECT DETECTION AND ARTIFICIAL INTELLIGENCE

Once multiple 3D point cloud scans have been precisely registered using the Vercator approach downstream data analysis is more readily achievable. One form of downstream analysis is automatic recognition of 3D objects. Automatic object detection can be based on finding features that match primitive shapes, e.g. planes, edges, cylinders. This process involves segmenting or classifying the point cloud into geometrically separate elements and then recognising them for 3D geometry model creation or extraction. This method is effective for simple elements that occur often, such as pipe cylinders in industrial

plants, but is less useful when the object complexity or variability increases.

Artificial Intelligence (AI) in the form of Machine Learning (ML) provides an effective approach to these more complex cases. ML is the “ability to learn without being explicitly programmed”, requiring many types of both wanted and unwanted objects to build the ML model. Correvate, in partnership with UCL, has been researching ML in relation to point cloud object extraction. Artificial Neural Networks (ANN) have existed for around 50 years as a technique and are very loosely based on the way real neural networks work in the brain, with neurons voting on the outcome. Deep Learning extends this with unsupervised learning, i.e. letting the model teach itself which features are significant. Higher level features are derived from lower level features to form a hierarchical representation. Figure 6 shows this approach used with chair data. The model was given point clouds of various types of chair to ‘learn’. It was then provided with a point cloud of an office, where the model detected the vast majority of the chairs in the scene, including those that were only partially captured.

### A CHANGE AGENT

A method which provides high-speed, robust, automatic alignment of hundreds of 3D point cloud laser scans paves the way for new working methods. The Vercator toolset lowers barriers to capture

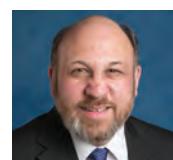
data onsite, speed of alignment, and convenience of downstream analysis. This ready availability of up-to-the-minute verifiable information is certain to improve many aspects of construction. In future, all buildings and structures may be scanned during construction and renovation, resulting in the ability to correct construction errors on a day-to-day basis. Further, with emerging techniques for recognising and ‘extracting’ complex objects, the benefits of the Vercator approach will also be enjoyed by downstream users of the datasets, in asset management for example.

### ACKNOWLEDGEMENTS

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### ABOUT THE AUTHOR

David Selviah is both a UCL academic at Reader level and CTO of Correvate Ltd, a UCL spin-out company commercialising his 3D point cloud processing research. For the last 31 years he has been at the Department of Electronic and Electrical Engineering, University College London (UCL) where, apart from his research on AI and creative algorithm development, he has specialised in the laser and optical field including LiDAR scanning. He has over 200 publications in his academic career to date.



# Drones - A Surveyor's Tool

**Drone technology is becoming widespread. On suitable projects drones enhance the speed and safety of site work. Once the imagery is captured, the deliverables that can be produced photogrammetrically are exceptionally versatile and easily fall into existing CAD, GIS, BIM and Virtual Reality workflows. Surveyors play a crucial role in embedding new technology and techniques into established 'best practice' ways of working. This article describes a recent project to demonstrate how the UAV was incorporated into a survey and the significant time, safety and cost value it added to the client and the contractor.**

## SATELLITES, DRONES AND LASERS

In 2017, SNC-Lavalin's Atkins business undertook a survey of a disused gas holder site for National Grid. The client required a 1:200 CAD topographic map and an orthophotograph mosaic of the 2 hectare site. They also needed a site video showing the condition of the gas holders themselves. The site was in a major city centre and all site work was completed within four hours.

In simple terms the site work had three major components. Firstly,

there was the need to install ground control in order to reference the project to British National Grid and meet the accuracy requirements of the project. Secondly, there was the need to capture the aerial imagery in a suitable format for stereo-digitisation; thereby, enabling the accurate production of 3D CAD topographic mapping. Finally, there was the task of visually inspecting and videoing the gas holders (which were between 20 and 40m high) with the drone.

To install control, a combination of methodologies was adopted. Network RTK methodology was used according to the best practice standards of the RICS for control establishment. This involved amongst other things re-measuring the control stations with a new satellite configuration. The first step was to measure control on the ground. Once the control network was in, a total station in reflectorless mode was used to coordinate elevation points on the top of the gas holder. This was done whilst waiting for the satellites to move into their new positions. It

was important to measure control at various elevations since the accuracy of the aerial triangulation is especially sensitive to changes in height and these need to be quantified to ensure an accurate and robust triangulation result; the final accuracy of the mapping is profoundly dependent on accurate triangulation.

Whilst ground control was measured using GNSS and Total Station techniques, the drone pilot commenced the video survey of the site and the gas holders. Capturing ultra-high-resolution video; be it, 4K, 2K or HD provides tremendous clarity. When only visual information is required, the drone is often able to offer a welcome substitute to a person working at height. The drone team comprised a pilot and camera operator. This enabled the pilot to focus on the safe flying of the drone platform and the camera operator to focus on getting the imagery and videos required.

Once the ground control points had been re-measured it was time for the drone to undertake the nadir



Figure 1: Total station measuring control.



Figure 2: Surveying ground control. (Photo by Drone Tech Aerospace)

photography of the site. The drone carried a full frame (35mm) DSLR sized camera and can cover 8ha in 20 minutes in one flight. This enabled the image acquisition for the mapping data to be completed very quickly. The drone has the audio footprint of a small electric mower and when operating at 100m above ground level, the aerial flight was a very discreet and rapid process.

### **MEASURING DETAIL FROM THE OFFICE**

Once in the office, production was undertaken following the businesses' long established photogrammetric workflow - an ISO9001 process which encompasses quality assurance, image enhancement, GNSS analysis, aerial triangulation and deliverable production. One of the strengths of our delivery pipeline is our ability to digitise from the imagery in stereo. This involves delineating assets and features directly from the imagery in 3D.

### ***... the aerial flight was a very discreet and rapid process.***

This is our preferred approach to mapping because each pixel sits adjacent to the next and each pixel contains information which influences the geometric fidelity of the survey, whereas with point data from aerial derived point clouds, no information exists between points i.e. there are gaps in data. This becomes evident when one zooms into a point cloud to delineate a hard edge such as a kerb or road edge. When doing this the points appear to spread out making the task less precise; however, it should be noted that a very dense point cloud can go a long way towards mitigating this issue. By drafting the CAD mapping straight from the ultra-high-resolution imagery in 3D, it enabled us to meet a very high standard of accuracy efficiently during the digitisation process.

### **SYNERGY IN METHODOLOGIES**

Utilising the drone in tandem with GNSS and the Total Station enabled the project accuracy requirements to be met and independently checked. Without the GNSS, it would not have been possible to install control at the required accuracy in the time available. The Total Station also enabled indirect measuring of critical control points in hard to reach areas that would have been nigh on impossible to reach directly. Once the control was in, the drone enabled the whole site to be easily imaged within an hour.

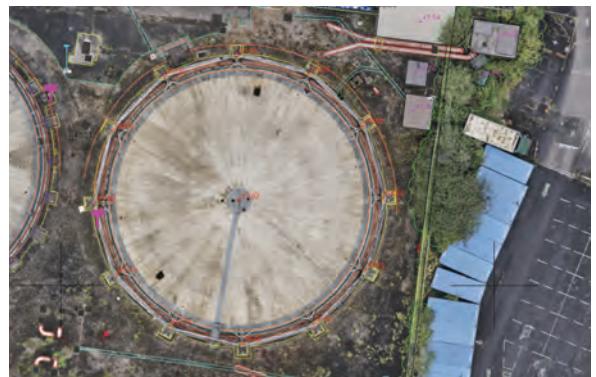
In deliverable production, photogrammetry permitted detail from hazardous and hard to reach areas to be digitised from the comfort of the office; essentially permitting one to substitute time spent in the field to time spent in the office. This generates time and cost savings, as well as reduced exposure to the health and safety hazards of

working onsite. Meanwhile, the ability to generate an orthophoto mosaic from the imagery added significant contextual information to the CAD drawing, making it more user-friendly and intuitive to interpret.

Further benefits were realised from the drone video footage of the site and the gas holder structures. This added significant value to the client by enabling them to visually assess the condition of the site and structures without the need to physically travel to the site.

### **FINAL THOUGHTS**

This project highlighted the importance of the surveyor in orchestrating and directing technology. Knowledge of how to utilise Total Stations, GNSS and photogrammetry was critical to



the success of the project. It was the combination of approaches used rather than any one tool in the box that enabled the client's expectations to be met in a minimally-disruptive, data-rich and time-efficient manner.

Drones are becoming increasingly ubiquitous across construction and infrastructure projects. The health and safety advantages, speed of survey and the diversity of captured data; be it, high resolution imagery or video are a few of the game changing benefits enabled by drone technology. Incorporating their use when appropriate into our existing and emerging survey workflows enables surveyors to bring to bear the latest technology for the mutual benefit of our clients and ourselves. Ultimately, it is for professional surveyors to champion and embed new technology and techniques into established 'best practice' ways of working.

**Figure 3:**  
*Orthoimage in CAD.*



### **ABOUT THE AUTHOR**

Charlton Bland is a chartered land surveyor and member of the Chartered Institution of Civil Engineering Surveyors. He works as a geomatics consultant for SNC-Lavalin's Atkins business and specialises in aerial photogrammetry and geodetic photo control networks for both manned and unmanned aerial surveys. Charlton.Bland@atkinsglobal.com

# Hydrographic Surveying in the Wake of Hurricane Irma – A Return to Basics

**Phil Payne gives a personal account of his experience in the Caribbean at the time of Hurricane Irma. He reminisces on the usefulness of basic techniques when the latest systems are, for whatever reason, not available, especially after being in the eye of one of the most powerful hurricanes ever recorded, and thinks that in the circumstances he is justified to say that no two days are the same.**

Organising equipment contracts, the hire of a suitable vessel, and bringing people together in a foreign country is never an easy task, but come September last year I was ensconced in the starboard forward cabin of a 47 foot power catamaran with the survey equipment all installed and humming away nicely. The backdrop was the island of Montserrat where I had joined the boat a week or so into the survey of its west coast. With impressive sunsets, generally calm seas and the occasional pod of dolphins to keep us company, the standard 12 hour working days were some of the most pleasant I have ever spent surveying.

*Figure 1:  
Bathymetric survey  
of Montserrat.*

## THE CALM BEFORE THE STORM

The boat was fitted with the latest multi-beam sonar and high

accuracy GNSS/IMU positioning system which enabled us to provide full coverage of over 52km<sup>2</sup> within a couple of weeks. This also included an extension to the south of the island to cover a scientifically important pyroclastic flow from the Soufrière Hills Volcano that had devastated the southern half of the island during the mid to late 1990's, a period when multi-beam and GPS were just starting to become common place in the hydrographic survey world.

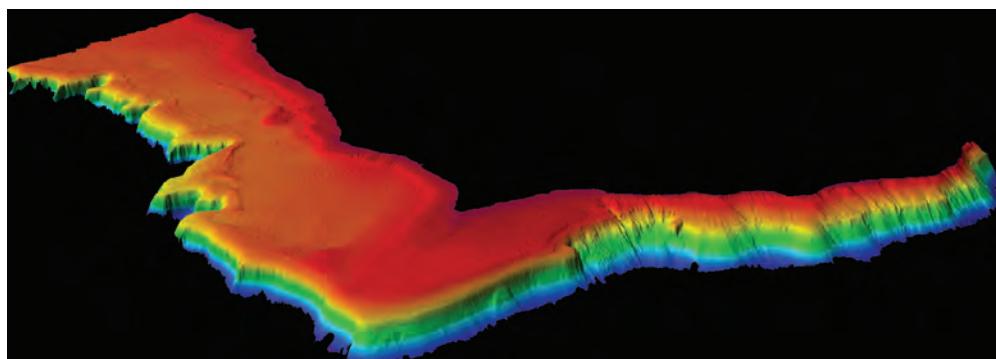
With a successful survey of Montserrat completed, see figure 1, we rose early to make the journey to Tortola in the British Virgin Islands where we had a further months worth of work to complete a survey of the Sir Francis Drake Channel, the main passage through the

British Virgin Islands. After a visit to the previously set up tide gauge to confirm it was still operational, we set about data collection in the waters to the north of Peter Island. While we were aware of a powerful hurricane heading for the Caribbean, their paths are notoriously difficult to predict, we were hopeful that it would still turn north and miss the island by a suitably safe distance.

Some 5 days later we pulled into the Marina, where we had hired the boat from, a full day before Hurricane IRMA was due to pass, still some distance to the north of the island. The local staff seemed calm as they went about securing all the vessels and allocating us rooms in the adjoining hotel. With the Hurricane still due to head north of the island, but a large storm surge expected, it was a close call. As we retired to our shared room, our mobile phones and tablets working overtime to access the various forecast centres that were slowly converging on the stark truth, that the hurricane was not turning north, but indeed was going to pass directly overhead. As the skies darkened and the wind speeds increased, I managed one last phone call, an interview for the BBC, before the internet went dead.

## THE AFTERMATH

As the hurricane passed, myself, Paul Aldersley (UKHO) and Ian Andrew's (Andrew's Survey) emerged from our room to try and locate our vessel with a view to getting back up and running



as quickly as possible to assist in ensuring safe passage for local vessels as well as any potential aid relief efforts. Unfortunately, our optimism as to the state of the boat was soon dashed literally against the rocks as after some searching we found her over 200m away from where she had been secured, one half on an embankment and the other half submerged, see figure 2. With an expectation of the hurricane to pass north of the island, we had removed the majority of the equipment, but left the pole mount and cabling in-situ to allow a quick remobilisation. A quick look at the pole made it very clear that we would not be remounting the multi-beam anytime soon, on this or any other vessel.

A day spent with the Governor, the initial UK Military presence and local disaster relief coordinators soon made it clear that with communications between the islands being sporadic at best, anything we could do to open up ports, jetties and other coastal facilities would be invaluable, so while Ian, our survey engineer was dispatched to the local radio station to assist in getting it back broadcasting, myself and Paul went about setting ourselves up as best as possible.

#### REVERTING TO BASICS

An as yet unnamed boat that had surveyed the hurricane almost unscathed, was kindly lent to us by the Moorings, which came with its own navigation suite including wide area differential GPS and single beam echo sounder along with a local skipper. We had started constructing a sweep out of rope, fishing line and divers weights (all recovered from the wreckage of the marina), but the equipment available on the boat undoubtedly saved us many hours trying to put together a technique that has always been a challenge to all but the most worked



Figure 2: High but not so dry.

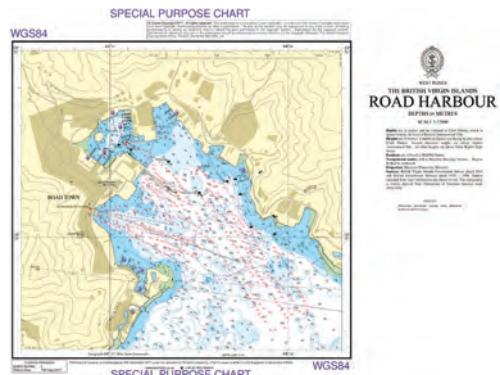


Figure 3: Chartlet surveyed after the hurricane.

up survey teams. Instead a lead-line was constructed and measured out using a 0.5m scale on top of the boat's cool box, as the one thing we couldn't scavenge was a tape measure (our own being underwater on the original boat). The lead-line provided a crude calibration for the single beam as well as allowing us to provide soundings along jetties where the boat was unable or we were reluctant to take it. In place of an online system to collect regular positions and soundings I employed an old fashion technique known as paper and pen.

The positions and corresponding depths, taken approximately every 10 seconds along with photographs and positions of those buoys and other navigation markers that had survived the hurricane, were recorded. These were typed up into an Excel spreadsheet to be sent back to the UKHO. Overnight the UKHO processed, checked and included the information onto special chartlets of the area, which I was able to take to the Disaster Management Teams the following morning to assist in the planning and movement of people and stores. Having initially turned down flights off the island a couple of days after the hurricane, 10 days later, with the main areas of interest completed, and the relief effort gaining momentum we finally flew home.

#### CONTINUED SUPPORT

As I write this article I have just received news that a UKHO contracted follow up survey, conducted under the Overseas Territories Seabed Mapping Programme, has just been completed. The data once processed and validated will be used to further improve the navigational safety of all vessels operating in the area. By helping to free up the waterways, I am grateful that I was able at the time, and am still involved in some small part in the huge rebuilding effort still ongoing in the British Virgin Islands and numerous other islands in the Caribbean hit by Hurricane's Irma and Maria. My thoughts remain with the local communities who continue to rebuild their homes, lives and livelihoods.

#### ABOUT THE AUTHOR

After 25 years' service in the Royal Navy (RN), predominantly as a hydrographic survey manager, Phil Payne has spent the last 3 years in various roles at the UK Hydrographic Office (UKHO). Currently the survey delivery manager, he both conducts and sub-contracts hydrographic surveys for a number of UK Government funded Programmes, including work in some UK Overseas Territories and Commonwealth small island developing countries.



# GeoDATA17 - Connecting Buyers and Sellers

**GeoAware hit just the right note with this year's GeoDATA 2017 London Showcase which took place at the ILEC Conference Centre in West London on 30 November.**

It attracted 32 exhibitors and a busy crowd of enthusiastic participants. There is no entry charge for attendees to GeoDATA. It is the exhibitors who pay to be there and so this is an event focused on enabling them to achieve a return on their investment. The seminar slots were all taken by exhibitors who were identified by their company name, to the point that some presenters were not actually introduced. Rather than allowing questions in the seminar room, those wishing to follow up on any points were encouraged to go to the presenter's stand, affording the opportunity for one-to-one discussions. This helps the exhibitors to cultivate potential customers whilst also ensuring that there were no overruns (or awkward questions) in the seminar rooms.

## DON'T USE THE DEFAULT!

There were few spare seats at the presentations, which were not always sales pitches. For KOREC the advance of geospatial technologies was set against the Gartner hype curve and we were presented with some good news: location-based 'geographical' jobs are set to grow by 35% per year. Let's hope that is not one of Gartner's 'inflated expectations'. At the other end of the day, Steven Feldman gave a keynote with fake maps as its theme. He started by asking those in the audience who produce maps, but do not

have cartographic or GIS training, to identify themselves. There were surprisingly few hands up. He described the traps waiting for ignorant and incompetent mapmakers and wound up with some intentionally misleading maps. His messages: don't use the default – particularly for choropleth maps, and make sure your maps don't

## *... and make sure your maps don't mislead.*

mislead. Be particularly wary if the results reinforce what you expected to see, he advised.

## FILLING A PHOTOGRAMMETRIC GAP

GeoXpere produces a medium format aerial camera which fixes onto the exterior of any plane. They claim to fill a gap in the market between UAV and conventional manned aerial survey platforms. Because it is so easy to fix to a platform, there is no need for a bespoke survey aircraft to sit in a hangar for a flying season. You just hire a plane when you need one. Technically, the interesting thing is their use of an advancing circular flight path of oblique photography rather than conventional parallel flight lines of vertical photos. This pattern, we were told, improves the photogrammetric geometry resulting in better city models. Pilots also apparently prefer the challenge of flying in circles as opposed to following straight lines! The cost of this solution is around £500 per km<sup>2</sup>. They use Skyline's PhotoMesh photogrammetric processing software.

Skyline also used a presentation slot to show off their SkylineGlobe 3D visualisation software, using a recent project to map Romsey. A UAV flew at 1,300 feet to capture the data with a flight time of two hours. The overall project cost was roughly £3,500 (2 hours fly time = £1,000; Ground Control Points = £500; Amazon Web Services = £500;

Photomesh = £1,500). We were then shown the results of a 3D map they were hosting, which seemed to gain the approval of everyone in the room.

## TREE MAP V2

Debbie Smith from Bluesky International spoke about their upgraded National Tree Map Version 2. She was happy to report that some of the problems from Version 1 like canopy cover not being clear and shadow problems leading to duplicate trees, had been solved. National datasets and R+D development were used to update and enhance the Tree Map before filtering out buildings, other tall objects and vegetation to create a dataset that was 90% accurate. The presentation concluded by answering the question, what can the dataset be used for? The answer: to find out how green your neighbourhood is, where leaves need to be cleared, worst affected hay fever spots and also to support air pollution studies. Smith hopes that in the future tree species will be integrated into the system.

## MAPPING SCARS

Mallon Technology talked us through the use of open source multispectral satellite imagery to create a national dataset of wildfire burn scars for the Republic of Ireland. Sentinel-2 and Landsat-8 satellites were used to capture the imagery where 335 burn scars were detected, amounting to over 11,000 hectares across Ireland. Challenges included a limited timeframe, cloud cover, size and storage of data and processing the data in a suitable software system.

## MISSING MAPS

A keynote speech 'Missing Maps: Putting the World's Vulnerable People on the Map' was given by Iain Bracknell from 1Spatial. He focussed on the work Missing Maps does and how we can all get involved. Each year, natural disasters kill nearly 100,000 people and many of the places affected are literally 'missing' from any map. With the help of volunteers and working with several organisations including the Red Cross and Humanitarian OpenStreetMap, Missing Maps

fills in these areas before disaster strikes, so that first responders have more of the data that they need,

3D layer which models vulnerable areas. A recent update gives greater depths than previously possible and

## **Pilots also apparently prefer the challenge of flying in circles...**

when they need it. 15 million map edits have been made since Missing Maps started. For more information visit [www.missingmaps.org/host](http://www.missingmaps.org/host)

also in 3D. Using the software to detect problem areas before they become hazardous could save the government billions in the long run.

## SHRINK-SWELL

Lee Jones from the British Geological Survey (BGS) informed a capacity audience about Shrink-swell. Shrinking and swelling of the ground is one of the most damaging geohazards in Britain. Many soils contain clay minerals that absorb water when wet (making them swell), and lose water as they dry (making them shrink) causing the ground to crack and in extreme cases collapse. Shrink-swell has cost the UK Government £7 billion over the past 25 years. He then demonstrated the answer - BGS GeoSure: Shrink-swell

## MAPPING FOR AUTONOMOUS VEHICLES

Getmapping has bought a Leica Pegasus: Two mobile mapping system. The company has been using it to scan the road network in London boroughs. Their system has seven cameras and two laser scanners. They claim an absolute accuracy of 20mm without ground control, by which they mean that 66% of points are within 20mm. With ground control, they claim to achieve 10mm. The data is currently being used to map road and cycle lane markings, parking bays and

&gt;



kerbs for use with the Appyparking parking app, but they also have their eyes on the provision of data for autonomous vehicles.

#### **COLLECTING DATA FOR GIS**

MGISS gave a presentation on GNSS and mass collection of data using "multiple non-survey operatives". The talk was also aimed at non-technical clients. The operatives use 'wearable' Arrow GNSS receivers and the company supplies solutions with the objective of satisfying the accuracy required by the client using as seamless a workflow as possible. They explained accuracy in terms of the position of assets in relation to each other. In other words, the objective is for the assets to appear to be in the correct place, relative to the map background and each other.

On a similar theme, David Crowther from Cadline shared some insights into utilising open source GIS interoperability to maximise data sharing across project teams. The tool he focused on was PostGIS

database. He showed how you could maintain spatial layers via QGIS desktop, and view your data onsite via mobile-compliant webGIS. The system now works in real-time and updates all connected software at the same time to avoid any miscommunication.

#### **UAV LOW-DOWN**

Topcon spoke about UAVs and, to their credit, only used images of quarries in connection with topographical surveying. They reported that the cost of obtaining standard CAA permission to fly UAVs is now £1000 and that improving battery life is making UAVs more attractive. They stressed the importance of getting the right drone. It was such a joy to listen to a professionally competent presentation on UAVs.

#### **AR SYMPHONY**

A speaker from Aligned Assets presented a history of Augmented Reality (AR) products and how they are used. A video on each product was shown including the Google

AR Core, Apple AR Kit, Microsoft HoloLens, Daqri Smart Helmet and of course the Symphony AR from Aligned Assets, which he explained could be used for security, boundary awareness, symbol recognition and more. It can also be used with any pair of Smart Glasses and this was where the speaker thought the future of AR lay.

#### **ARE WE CENSUS-READY?**

GeoPlace's talk from Nick Griffiths was all about AddressBase and its role in the 2021 census. Working with ONS (Office of National Statistics) and using data from councils, Royal Mail and Ordnance Survey, AddressBase is to be used to make sure every household is sent a letter, that postal returns are tracked and to identify where follow ups are needed. He finished with the question, are we census ready? Yes, but more data is needed (like type of property etc).

In summary, this was a pleasing day and it is hard to imagine anyone leaving GeoDATA17 disappointed.

## **MapAction: Mapping for People in Crisis**

**The RICS 'Christmas' evening lecture took place at Great George Street on 7 December. The speaker was Alan Mills from the charity MapAction who spoke to a very nearly full house. He started by explaining how MapAction came into being 15 years ago. It was originally called 'Aid for Aid', but that did not mention geospatial. The fashion at the time was for all aid charity names to be suffixed 'without borders', but 'Maps without Borders' would have raised some eyebrows and so MapAction came into being.**

Over the years MapAction has been honing its incident management

skills. The charity has a clear aim – to provide geographical information immediately after a disaster has struck that will enable people to receive food, water, shelter and medicine in the first critical weeks.

Mills summed up the task in a series of questions. What has happened? Where is the affected area? Who is affected? How can they be reached? What do they need? Where are other relief organisations working? The result is a 'Who, What, Where Map'. In particular this focuses on the activities of other charities and highlights the gaps that need filling. The objective is to provide a common operating picture to aid co-ordination of the relief effort and to provide

daily updates. In addition to its well-established role in disaster response, the charity now encourages disaster preparedness, working with agencies in the most vulnerable places.

As well as describing the roles of those involved in the charity, Mills described his personal experience in responding to the recent hurricane disaster in the Caribbean. He had worked in the British Virgin Islands (BVI) some years previously on a GIS project and had retained a copy of the data, which was just as well, because the server holding it on BVI had been destroyed by the hurricane. His before and after images brought home the horror of the event.

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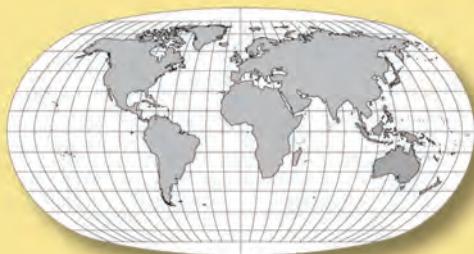
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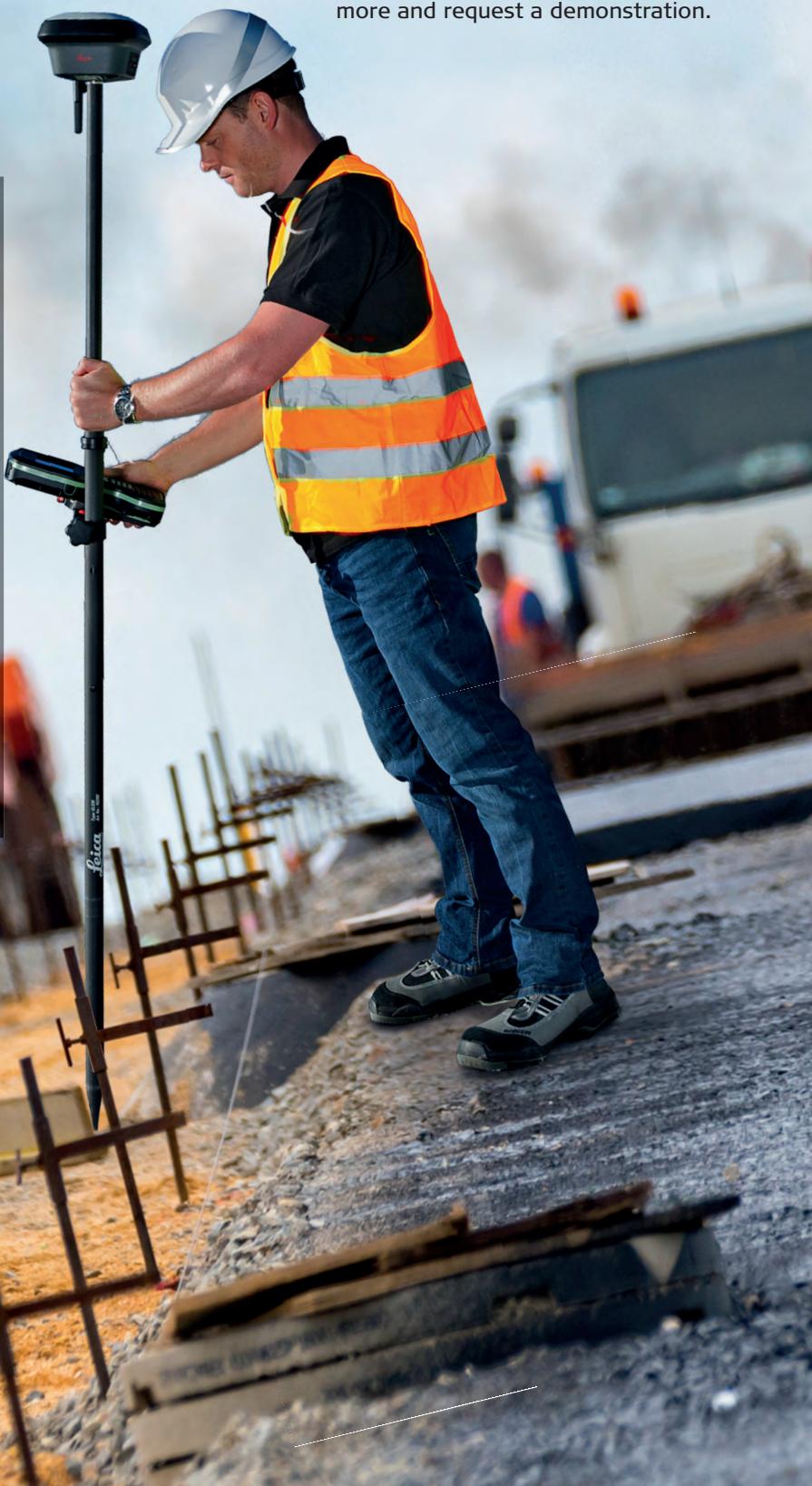
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