Engineering surveying *showcase* 2013

ISSUE TWO

FEATURES:

Non-contact measurement for rail

Laser scanning an ancient rail tunnel

UAVs: suppliers, flyers and software

BIM at work at RICS

Combining laser scanning and sonar

PLUS

SOFTWARE FOR GEOMATICS •
Market feature on new product launches •
Where to find a survey company •
and more

Leica Geosystems Ltd is expanding - to a new flagship building

Come and experience our new UK Headquarters

In response to the company's growth Leica Geosystems Ltd is expanding to a new flagship facility which will be our new UK and EMEA Headquarters.

You are invited to attend special open days at our impressive new facility on **21st or 22nd November 2013**.

We believe our expansion offers our customers a range of benefits that only Leica Geosytems Ltd, as an innovator, manufacturer and supplier providing service, support and training can offer.

Don't take our word on that – come and see for yourself!

Come and join us as we launch a new era for Leica Geosystems Ltd.

What can you expect on the day?

- An informative tour of our new UK and EMEA HQ
- Dynamic presentations showcasing all Leica hardware and software
- The first chance to see our fantastic new 200-seater training and seminar facility

As industry leaders we continually strive to enhance every area of our business and we want you to benefit from this exciting new development.

To book your preferred invitation day and tour email **collette.fallon@leica-geosystems.com**

Leica Geosystems Ltd
Hexagon House, Michigan Drive, Tongwell
Milton Keynes MK15 8HT United Kingdom
uk.sales@leica-geosystems.com
www.leica-geosystems.co.uk

- when it has to be **right**

Leica Geosystems

Engineering surveying*showcase* 2013 ISSUE TWO

Engineering Surveying Showcase is a twice-yearly window into the surveying industry. It is published for the benefit of the industry and for the professionals who work in it.

Our mission is to show to the survey industry's customers, clients and employers, whether as individual surveyors, managers or other professional disciplines, such as engineers or architects, the latest developments and applications in surveying technology and techniques.

Further details from:
The Editor, Engineering Surveying Showcase, 2B North Road, Stevenage, Herts SG1 4AT, tel: 01438 352617, fax: 01438 351989
e-mail: **editor@pvpubs.demon.co.uk**
or visit our website at: **www.pvpubs.com**

Publishers:
PV Publications Ltd,
2B North Road, Stevenage, Herts SG1 4AT, Tel: +44 (0)1438 352617,
Fax: +44 (0)1438 351989, e-mail: editor@pvpubs.demon.co.uk

Editor: Stephen Booth ***Technical Editor:*** Richard Groom

Advertising sales: Sharon Robson ***Subscriptions:*** Barbara Molloy

Printing: The Manson Group, St. Albans

*Don't miss the next issue of **Showcase** with our review of sensors for Geomatics. Issue No 1 for 2014 is out 28 April 2014**

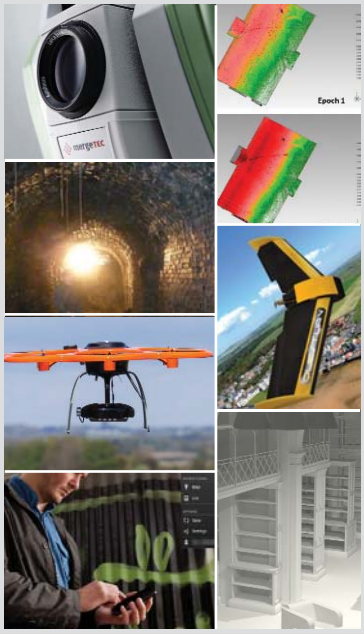
****Can't wait?***
A limited number of copies are still available of the spring 2013 issue featuring the latest sensors and applications and more. Call 01438 352617 for details.

To receive FREE copies of ***Showcase*** you must be one of the following:

- a subscriber to *Geomatics World*
- an RICS Geomatics Group member
- a member of the Irish Institution of Surveyors (IIS)
- someone who recommends or purchases surveying technology or surveying services.

To register or subscribe, go to: **www.pvpubs.com**

THIS ISSUE



COVER STORY

All of the images featured on the cover are from articles and features in this issue of Showcase and reflect the wide ranging editorial coverage.

- *Leica Geosystems, Trimble, Sensefly, Storm Geomatics and Anita Soni.*

Showcase is published for the benefit of those who work in, or supply, the geomatics industry. Our aim is to raise awareness of the new opportunities which technology is bringing to the traditionally narrow field of surveying.
Showcase is currently published twice yearly (April and October) and distributed to over 6,000 surveyors, engineers and professionals who use spatial data in the built environment.

The easiest way to receive *Showcase* is to go to our website at: ***www.pvpubs.com*** or call us on 01438 352617

Nothing Comes Close

Actual Size

The **Trimble® R10 GNSS System** is the first of its kind.

Trimble's HD-GNSS processing engine – vastly reduced convergence times that, in turn, reduce your occupation time when collecting high position and precision reliable data.

Trimble® xFill™ technology – xFill enables you to continue taking measurements with survey-level precision if you've lost signal.

Trimble Surepoint™ technology speeds up your survey time and provides continuous traceable data.

Trimble Authorised Distribution Partner

www.korecgroup.com
info@korecgroup.com
tel UK: 0845 603 1214 IRE: 01 456 4702

Measured Solutions
Construction | Surveying | Mapping

KOREC™

It's all about geospatial technology

SHOWCASE is all about raising awareness of geospatial technologies and techniques amongst surveyors, engineers and others whose businesses or organisations rely on them. Each of our twice-yearly issues presents the latest in field, desktop or cloud solutions. The autumn issue is mainly about software, while in the spring we look at data capture through hardware and sensors. Both issues however will contain news and features of all types of geospatial technologies. Typical in this issue is the coverage of the Leica MS50 (page 08), a multi-sensor system that may look like a total station but is capable of so much more. Surely the shape of things to come for surveying.

The major feature in this issue is Software for Geomatics and GW's technical editor **Richard Groom** introduces the review with some thoughtful words on page 28. Note the steady migration to cloud based solutions, the development of machine control and other specialised applications.

". . . a hitherto hidden tunnel that may just be the first ever to have been built for rail tracks."

We have also carried out a major study of UAVs – unmanned aerial vehicles also known as small unmanned aerial systems or unmanned aircraft (UAs), the latter is the term used by the Civil Aviation Authority (CAA). The market has evolved from the military drones, which are increasingly replacing piloted aircraft, and is maturing rapidly. The major geospatial equipment suppliers are following a well-trodden path where new technologies are concerned: they watch how the independent start-ups and risk takers perform and if these new businesses find customers and succeed, they form a partnership that may eventually lead to a buy-out. This has happened with both Sensefly (Trimble) and Aibotix (Leica Geosystems). Although there are suppliers we haven't listed they are mainly local to the US or they didn't respond to our many requests for information. The feature is backed up with articles explaining the many applications for UAV surveys and what it's like to be an unmanned aircraft pilot (yes, they are still called pilots and need certification form the CAA). My thanks again to Richard Groom for collating the information.

Next we have two articles on rail related topics. **Anita Soni**, a PhD student at University College London, writes about her research into non-contact measurement systems for monitoring trackside infrastructure, particularly on the work being carried out at London Bridge Station. Meanwhile, Wessex Archaeology report on a project to scan a hitherto hidden tunnel that may just be the first ever to have been built for rail tracks. The project utilised the versatile and lightweight Faro 3D Focus scanner.

The previous issue of *Showcase* (spring 2013) carried a major focus on BIM: building information modelling. Backed by the government, the technique must be applied from next year onwards to all public sector projects over £10 million. The use of BIM during the design, development and construction phase brings demonstrable benefits. But so does it if also applied throughout a building's whole life cycle. BIM is not just for new build. **Less Pickford** reports on how the Royal Institution of Chartered Surveyors has adopted BIM for facility managing its headquarters in London (built in 1896). Surveyors have captured a 3D model of the building's interior using laser scanning that will be used by RICS's facility manager to assist in future management and development.

Finally, I am delighted to present details of an award winning offshore metrology project that combined laser scanning and multibeam sonar data to help design and install a spool piece on the ocean floor with complete success.

Enjoy this issue of *Showcase* and if you need to stay up with geospatial technology between our publications follow our bi-monthly Geomatics World journal, published on behalf of RICS. A digital subscription is free of charge whilst a full printed edition, together with password access to our searchable archives, costs just £35.00 for new readers.

Stephen Booth, Editor

**If you know of engineers and project managers who would benefit from a copy of Showcase, please drop us a line and we'll earmark them for a free copy.*

*The next issue of Showcase will be spring 2014. Copy date for editorial is **24 March** for publication on 28 April. Copy date for advertisers is **11 April**.*
• Call 01438 352617 for more details.

Improving economic runes are helping drive development across the spectrum of geospatial technologies. Below we highlight the more significant new launches but watch out for more from the Intergeo, which we'll report on in the Nov/Dec issue of Geomatics World.

Updates for RealWorks

Trimble announced version 8 of its RealWorks software including a new 3D database engine, automated targetless registration and web viewing capability incorporating the Scan Explorer interface. The new database engine will allow up to five times more data to be visualised and managed, compared to the previous version.
An automated targetless registration function identifies planar objects in each scan and matches the planes from multiple stations, creating a combined dataset. The function enhances productivity in the field by eliminating target placement prior to data capture in applicable environments. Office processing time is also reduced by the fully automated function.
Sharing of data with clients has been enhanced by the addition of a Publisher function that allows projects to be custom packaged for viewing via Internet Explorer.

Updates for iCONstruct

Leica Geosystems released an enhanced version of the iCONstruct field software, which significantly improves and optimizes construction workflow with the Leica CC50 and CC60/61 field controllers and the gps 60 and robot 50 positioning sensors. A new Roading application is an option for the iCON build and iCON site software, also available for the CC60/61 controllers with their 7" inch large display. Roading enables users to stakeout individual road lines and slope elements providing different views. Users working with a Leica iCON gps 60 antenna can now receive coordinate systems via the RTCM v3.1. message format using Leica's SmartNet network RTK correction service.

Scanning under water

The INSCAN underwater laser imaging system provides fast, high resolution 3D data capture for surveying, as-builts and monitoring. It uses proprietary technology developed by 3D at Depth and engineered by subsea engineering company CDL for use at depths of up to 3000m. The system collects up to 40,000 points per second, provides a 360° × 30° field of view and can either provide real-time operator measurements or output to industry standard point clouds.

MultiStation is scanner, GNSS and total station

Leica Geosystems introduced the Nova MS50 MultiStation, a combined high end total station with GNSS options, sophisticated imaging and a 1000 pt/sec laser scanner. The Nova range includes a new processing package, Leica Infinity, which replaces LGO and a new MultiWorx plug-in for AutoCAD for easy creation of survey deliverables from MultiStation laser scanning and imagery. The company has also released the TS50, a new high precision total station and the TM50, its monitoring counterpart, along with an upgrade for GeoMos to handle scan data. See page 08 for more details.

Storm GeoRiver

Storm GeoRiver is river model data preparation software for surveyors and hydraulic engineers. The software automates two-way exchanges between ISIS, Mike 11 and Hec-Ras river model formats and provides tools that quickly create river models from survey or existing data. GeoRiver is a partnership between Storm Geomatics and software specialists Borwell Ltd. The software is available on a 30-day cloud licence or through annual subscription.

Photogrammetry from UAV

Trimble introduced version 3.0 of its office surveying software, Trimble Business Center (TBC) with a powerful suite designed to manage, analyse and process all field survey data, including optical, GNSS and imaging data.Version 3.00 introduces a new photogrammetry module for importing and working with flight data and images collected from the Gatewing X100 UAV and optical instruments, such as the S8 total station with Trimble's VISION technology. Based on the latest software from Inpho, the module provides office surveyors with the capability to process complete mapping projects containing aerial data, GNSS and total station observations. Surveyors can produce deliverables, including georeferenced orthophotos, 3D point clouds and digital surface models directly from TBC.

New airborne sensor

Leica Geosystems has announced a new generation of its airborne digital sensor, the ADS100. Introducing a unique focal plate design, the ADS100 offers a swath width of 20,000 pixels for all multispectral bands (RGBN) and multispectral capability in forward, nadir and backward. The ADS100 provides the world's first large format CCD line with TDI (Time Delay and Integration) to increase sensitivity despite a smaller pixel size. By doubling the cycle rate, high-resolution images can now be acquired at higher ground speeds. A new gyro-stabilised mount, the PAV100, is equipped with revolutionary adaptive control technology.

Spherical camera

Point Grey has released the Ladybug LD5-U3-51S5C, a 30 Mpx camera that covers 90% of a full sphere, has a 5Gbit/sec USB 3.0 interface, provides high dynamic range, superb image quality and maximum user flexibility.

The camera uses six high sensitivity 5Mpx Sony ICX655 CCD sensors. Five CCDs are positioned in a horizontal ring and one points vertically upwards. Unlike rolling shutter CMOS, global shutter CCD technology prevents motion artifacts when capturing images from a moving vehicle. All six Ladybug5 imagers are pre-calibrated in Point Grey's manufacturing facility, removing the need for in-field

Next generation tablet

A new tablet PC is billed as the "next generation" for surveying. The Trimble Tablet is a lightweight and rugged field computer that can operate with the company's suite of receivers and total stations. With Trimble Access field software on board (see inset), the Tablet streamlines the flow of information between the field and office, whilst allowing surveyors to run applications for office work directly from the field. The tablet offers a 7" capacitive multi-touch screen in a unit that measures 6.3" × 9.6" and weighs 3lbs. Extended battery set offers up to 16 hours of operation.

calibration. They capture, optionally compress, and transmit full bit-depth (12-bit) images to the host PC where a unique software post-processing workflow can be used to apply white balance, gamma, smear correction, fall-off correction and other image processing.

Slate controller

The Trimble Slate Controller combines the convenience and ease-of-use of a smartphone with rugged durability as well as optimisation for Access field software and the R4 GNSS receiver.

Offering voice, SMS text, and 3.75G cellular data transfer capabilities on GSM cellular networks worldwide, the controller is a rugged device that enables enhanced connectivity in the field. Its wireless communication capabilities keep surveyors in the field connected to the office. It has a 4.3" capacitive touch, Gorilla glass display providing superior sunlight readability.

Next generation UAS

Described as a "next generation" Unmanned Aircraft System (UAS), Trimble announced the UX5 aerial imaging rover to succeed the Gatewing X100. Offering enhanced image quality from a mirrorless 16Mpx camera with a fixed focal-length lens, the large field of view allows the UX5 to cover 50-75% more area and is capable of producing 3D surface deliverables with a ground sampling distance of approximately 24mm. **Check out Showcase's UAV feature. Begins page 13.**

Apps for scanner

Laser scanner developers Faro report an increasing number of apps available to help users with their scanning and software. In addition to free apps, there are special ones from software partners. In many cases, the apps ensure that it is unnecessary to purchase complex additional software for CAD programs.

There are useful plug-in apps that can be installed in all versions of Faro's scan processing software SCENE that allow for the exact evaluation of 3D laser scans in just a few steps. SCENE is supplied with every Faro Focus3D laser scanner but the 3D App Centre offers specific tasks such as easy calculation of volumes and production of 3D videos. Apps from software partners include for Kubit users an AutoCAD free plug-in that allows measuring points directly into the AutoCAD 3D viewer. Specifically for surveyors, there is an app from ATS that makes the monitoring of scan data registration more transparent and more accurate. All apps are tested by Faro prior to being offered in the Centre.

Non-contact video gauge, with precision

KOREC is now the sole UK distributor of Imetrum's Video Gauge, a non-contact precision measurement video monitoring system for rail tracks. The system is ideal for applications where there is a need to accurately measure dynamic deflection at a distance and under train loading with sub-millimetre accuracy. Recorded video data can be stored for analysis later, or processed and transmitted for real-time monitoring.

Rangefinders

Two new TruPulse laser rangefinders from Laser Technology, Inc., the 200X and 200L models measure slope distance and degree of inclination, enabling calculation of horizontal and vertical distances, height and 2D missing line values. The 200L has 0.5° relative inclination accuracy whilst the 200X can connect to a smartphone, tablet, Win mobile device or almost any GPS handheld via Bluetooth.

BRIEFS

Leica Geosystems has announced worldwide distribution rights for the Aibotix Aibot X6 hexacopter. The company also has the licence for worldwide distribution of the Dragon 35 synchropter from SwissDrones.

Spectra Precision has introduced the ProMark 700 GNSS RTK rover designed for network RTK applications. Weighing only 650 grams, the receiver is believed to be the lightest GP+GLONASS RTK smart antenna available. The unit has a ten-hour battery life between recharges, a rugged, waterproof design and a wide operating temperature range.

Z/I Imaging has released V6.6 of its sensor software PPS, introducing 'PureColor Technology'. As part of a broader focus on radiometric enhancements and simplified processing, the technology boosts the dynamic range of the output image and protects all information collected even in high illuminated and shadow areas.

Leica Geosystems has updated its Zeno Office v3.1 and MobileMatriX v5.1 software, with support for the Leica CS25 GNSS tablet, as well as Esri ArcGIS 10.0/10.1. With the CS25, asset collection and post-processing of GNSS raw data can be done in one application and on one device.

Equipment theft continues to be a worry for survey firms. M&P Survey Equipment

(www.mpsurvey.co.uk) is offering a solution involving an alarmed wire, which is looped through the equipment and can be attached to an adapted survey nail or Feno marker.

Leica Geosystems has entered the mobile mapping business with the *Pegasus:One*, which allows customers to use their existing, terrestrial scanner in profiler mode, for mobile mapping. It is vehicle independent and comes self-contained in two Pelican cases. The software platform is ArcGDS, a complete solution from data acquisition to post-processing to database that offers users immediate access to their imagery and point cloud data in the same GUI.

Atkins is introducing earthmine, a 3D mapping solution, to the UK engineering market, following trials in Bristol, London, Southampton and Oxford, along with significant lengths of the M25 and M11. The imaging system provides corresponding XYZ data point for every pixel in every image. As a 'value added reseller' Atkins can offer cost and time savings to engineering projects through high-quality 3D imagery and mapping.

Leica Geosystems' accredited distributor and service partner Opti-cal Survey Equipment has added the Cobra wi-fi ground penetrating radar to its portfolio. The Cobra GPR can be used to image the inside of different materials and structures. Collecting data from hundreds of thousands of pulse reflections every second, the Cobra helps identify objects below ground. The unit is hand-propelled and similar in size to a lawnmower.

Chinese developer CHC has introduced the X91+ GNSS receiver featuring advanced network RTK positioning, internal UHF Transceiver for simplified base/rover operation, Carlson's SurvCE 3.0 field data collection software and optimised GNSS data Management with 4Gb internal Memory. Visit: www.chcnav.com

Trimble has integrated SketchUp file import/export into its Business Center (TBC) office software. This allows the calculation of points based on 3D SketchUp Pro models, to transfer the points into Trimble Access field software. Business Center's exporter routes survey data back into SketchUp for an accurate portrayal of the land layout ahead of design.

STOP PRESS!

Showcase will be visiting the Intergeo trade fair in Germany. We will report in more detail in the Nov/Dec issue of *Geomatics World*. But already we've had a sneak preview of a major new laser scanner. The Faro Focus3D X 330 is reported to make outdoor scanning significantly easier and comes with a range of up to 330 metres and can scan in direct sunlight. More on this new device in the spring issue of *Showcase* next year.

Introducing the Leica Nova MS50

– a total station with full laser scanning functionality

Launched earlier this year, the MS50 constitutes the third member of the Leica Nova family, joining the TM50 and the TS50 to complete Leica's latest triumvirate of 'precision excellence'.

Like its monitoring and measuring cousins, the MS50 demonstrates the kind of superbly accomplished technical capability that we have come to expect from Leica Geosystems – especially where the high end market is concerned and this piece of kit certainly doesn't disappoint. The Nova's sheer finesse is what sets it a cut above the rest. It is unlike anything else currently available. The unique MultiStation capability is a real masterpiece of technical integration. But for all this, the MS50's grand entrance onto the surveying scene has been dogged by the same recurring question right from the offset: 'yes it can do everything'; but what's it really for?'

The Lowdown

Dubbing it, "a fusion of technologies", Leica's 'MergeTEC' cleverly combines 3D scanning and total station capability with comprehensive digital visualisation and GNSS tools. The result – rather than simply the next model in the ongoing evolution of pre-established technology – is an integrated solution to help redefine the way in which end users tackle their workflows.

"It's not an improvement on an earlier model", explains **Stuart Nash**, Opti-cal's resident laser scanning expert, "it's something entirely new – and naturally it's unsurprising that it has taken some time for people to fully understand the benefits."

Put simply, the MS50 takes all the accuracy and durability established by the traditional total station model, and adds laser scanning capability into the mix. Where previously, jobs that required aspects of both measurement and scanning would require two or more instruments, the Nova neatly streamlines your technical inventory by offering both solutions under one roof. "It's more an extension of traditional workflows than a disruption," explains Nash. "Think of it this way, you no longer need to have two instruments in the field to fulfil two separate aspects of surveying, because you now have one intelligent solution that can do both."

In the Nova's case, the increased cost is far from indicative of increased complexity, as the MS50 actually simplifies workflows by pragmatically re-imagining how professionals operate; giving the user access to a versatile range of tools that are perfectly integrated without the need to switch between complicated instruments and software packages. "The ease of the MS50 workflow and its integration into Leica's SmartWorx makes it a versatile tool that you can use anywhere, anytime, not just on speciality projects," adds **Jamie Gillis** of The Nova Learning Network. "For one, it completely eliminates the need for targets and point cloud registration – two of the most intimidating aspects of the 3D laser scanning workflow for professionals who are new to scan technology. For those that have never worked with 3D datasets before," he continues, "the Leica Nova MS50 makes it easy to get their foot in the door."

In a nutshell, Leica Geosystems has produced a unique instrument that occupies a previously unaddressed niche; for those whose surveying tasks involve travel – weight and bulk restrictions – or organisations who are looking for an instrument that elucidates a holistic view of surveying processes, the MS50 really is the 'universal solution'.

• If you want to book a demonstration, or simply find out more about how the MS50 can help you with your projects, get in touch with Opti-cal today: ***sales@surveyequipment.com***

opti-cal
surveyequipment.com

Now available for hire or purchase

The Leica Nova MS50 MultiStation

the new dimension in measuring technology

The MS50 is a revolutionary solution with advanced measuring technology that provides unchallenged accuracy and quality, yet does not compromise on ease of use.

Proven Technology for Unmatched Versatility
- Reflectorless range beyond 2000m
- Highest protection rating in the industry
- Withstands MIL blowing rain test

Integrated Scanning of Every Detail
- 1000 pts/sec up to 300m
- Scan range up to 1000m

Image Assistance for Every Situation
- Automatic capture of panoramic images
- On board surface modelling
- 30 x magnification for high resolution images and precision target acquisition

FULLY ACCREDITED

- when it has to be right

Leica Geosystems

Authorised Distributor & Service Partner

To find out more about how the Leica Nova MS50 MultiStation can help with your project, get in touch now

surveyequipment.com

Head Office – Reading	Gatwick Office	Huddersfield Office	Milton Keynes Office
01189 820 500	01293 538 730	01484 443 270	01908 683 726

sales@surveyequipment.com

MONITORING RAILWAY INFRASTRUCTURE: non-contact measurement techniques

Monitoring railway infrastructure is a challenge for surveyors and engineers. Non-contact techniques offer a safer and better solution argues Anita Soni, a doctoral student at UCL sponsored by Network Rail's Thameslink Programme.

THIS STUDY LOOKS at monitoring in a railway environment, with a particular focus on the potential of non-contact measurement techniques for monitoring. These might include methods such as terrestrial laser scanning (TLS) and photogrammetry. Currently typical railway monitoring activities involve direct contact through the placement of targets (e.g. prisms) or sensors onto the structures being monitored. This only provides discrete information and is an intrusive method where drilling, clamping or gluing is required. It can be expensive whilst creating safety and timing issues both at installation and subsequent maintenance. Technologies such as laser scanning or photogrammetry could deliver a "target-less" solution as well as providing continuous surface measurement information of railway infrastructure.

Objectives

The first objective for the study is to review the existing monitoring systems along the TLP and compare them to other rail industry peers (e.g. Crossrail Ltd) and non-UK rail projects, (e.g. Amsterdam Metro North-South line). As well as comparing the technologies being used, this provides an opportunity for TLP to assess whether lessons can be learnt from peer projects to enhance its monitoring.

The next objective is to identify where TLS and photogrammetry could enhance or supersede existing systems for railway monitoring in the future. The first two years of the study has involved evaluating current state-of-the-art practices of monitoring, e.g. ground movement and structural monitoring, and seeing how these can be developed and applied in the railway environment. This is being done through a mixture of lab testing and site work.

Lab tests have been set up to look at the performance of total stations typically used for automatic/manual monitoring and to compare them to laser scanners. This includes looking at the accuracy and precisions between the instruments when controlled movement of a target or feature is applied. The main challenge of implementing laser scanning for monitoring is to see whether the accuracies required can be reached and maintained. Some specifications dictate at least a 1mm accuracy of the measurements, which is not currently possible for a laser scanner. From literature it can be seen that surface models can provide sub-millimetre accuracy, providing a suitable solution to these requirements. Also proper calibration procedures need to be developed in order to model and correct for the systematic errors present in the scanner's data measurement that could be hindering potentially better accuracy and precision. These lab tests then provide information of what can be feasible on site.

Study test sites have been selected by searching for a series of real scenarios representative of railway monitoring (e.g. railway track, bridges, arches etc.), which would logistically allow for these alternative monitoring techniques to be adopted in parallel. This enables analysis of the different instruments and their comparative performance. The expected outputs for each of the sites include a qualitative and quantitative analysis between these techniques. Two of these sites are discussed briefly.

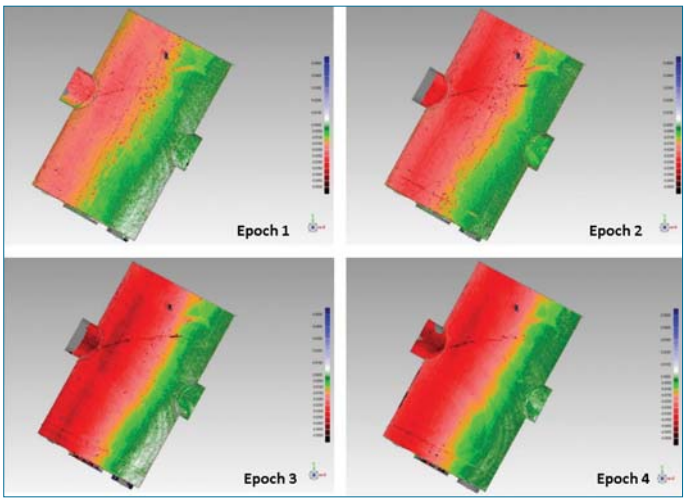


Figure 1 - Displacement maps of arch movement (in plan)

London Bridge Station redevelopment project

As part of the TLP, Key Output 2 (which runs from 2012-2018) involves a major redevelopment of London Bridge Station. Due to the planned construction work, many typical railway infrastructures are required to be monitored continuously throughout the project, in particular the railway track and arches. This has provided an ideal opportunity for setting up some of the test sites.

London Bridge arches

The masonry arches of London Bridge are located at street level directly below the platform level of the station. The arches are required to be monitored prior to and during various stages of demolition and construction works. Manual monitoring has been implemented here on a daily and weekly basis depending on proximity to works and their nature. Automated monitoring has not been applied at arch level to date due to restricted site lines and continuing changes to work progress.

The manual monitoring, which includes prism measurement in arch arrays and level measurement along wall bases, has shown that some settlement has occurred during piling works. However, the monitoring system can only show the movement of a particular prism or level measurement point and not of how the full structure itself is settling. This provided an opportunity to use laser scanning to give a visual validation of the movement of the structure.

Figure 1 shows displacement maps over an 8-week period after the settlement had been measured. It shows how the crown and west pier of the arch continues to settle (amber and red), whilst the east pier remains relatively stable (green). This coincides with the prism measurement information. It has also given engineers an enhanced 3D visual representation of the movement to carry out further analysis.

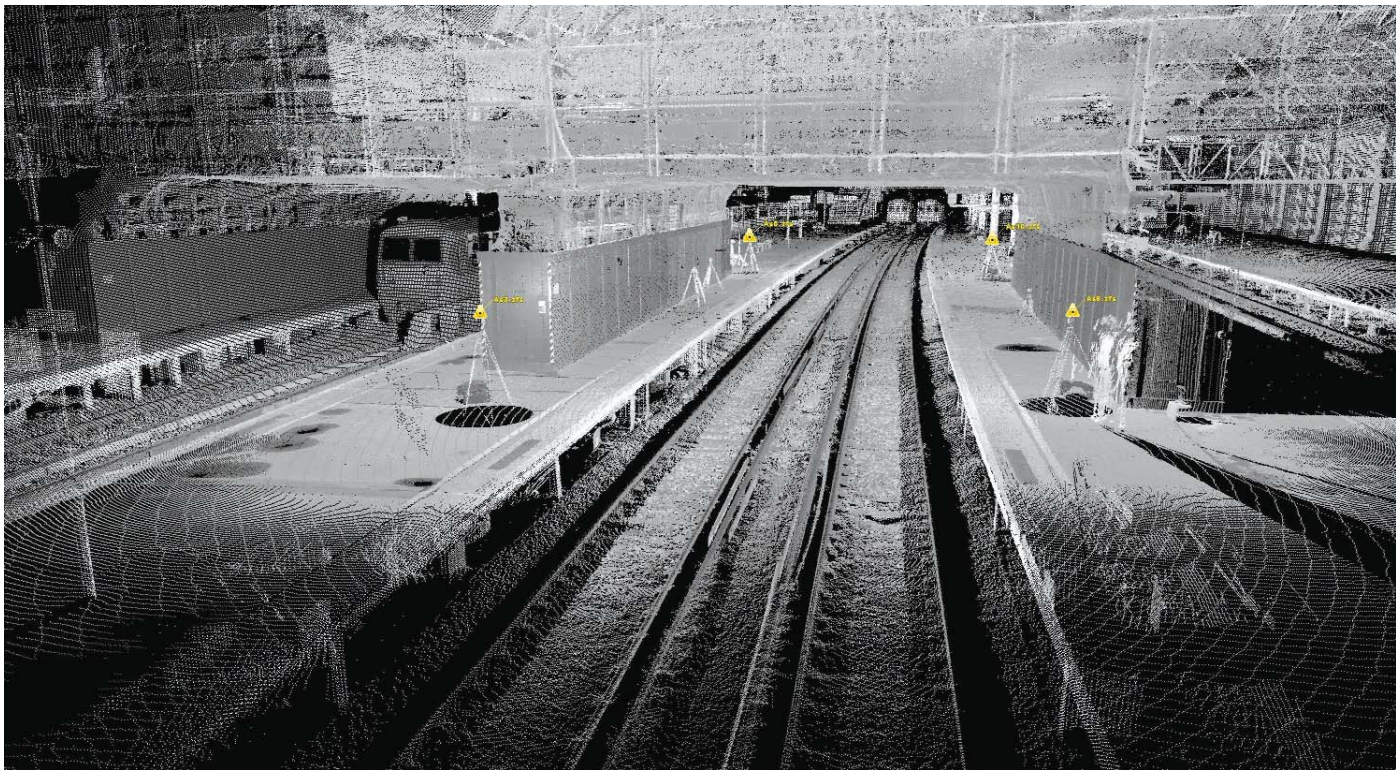


Figure 2 - Point cloud of Eastern Gantry at Platform 12 and 13, London Bridge Station.

Figure 3 - Cross-section of platform and rail track at London Bridge

London Bridge tracks and platforms

Real-time monitoring is required for all tracks and platforms that fall within the demolition or construction zone. A combination of manual and real-time monitoring has been implemented here to date.

Currently one of the major problems for track monitoring is that the prisms get knocked during engineering hours as works take place. This sets off spurious movement triggers requiring analysis by engineers and continuous maintenance of the system. One of the aims of this site is to explore a fully the "contactless" approach to monitoring of the tracks avoiding targets and therefore issues such as target disturbance and spurious movement reporting. The aim is to revisit a particular section of track and scan it at regular intervals over the year. The methods of producing models and the ability to extract relevant track geometry for monitoring purposes will be explored. Figure 2 shows the platforms where scans have taken place at London Bridge Station (yellow triangles represent scan positions). Figure 3 shows the initial cross-sectional view of the point cloud and the problems with occlusions that will need to be dealt with to obtain sufficient track geometry.

These are a few examples of the test sites chosen to look at a non-contact approach for monitoring railway infrastructure. The remainder of the third year will focus on acquiring data for all the sites. Once the data has been acquired, the next step will be to explore data presentation methods in the monitoring context for each of these scenarios. Challenges will include handling the vast amount of data as well as visualising the most relevant information into a reporting system. This will be carried out in the final year of the study.

About the author

Anita Soni is currently an Engineering Doctorate student at the UCL/Thameslink Programme. She has worked as a surveyor at Plowman Craven Ltd, where she specialised in laser scanning (including terrestrial, close-range, head and body scanning) and worked on a variety of projects from construction to entertainment. Whilst studying for her undergraduate degree, she had an internship there and was offered sponsorship for the last two years of her degree. Anita Soni has an MEng in Geomatic Engineering and MRes in Virtual Environments Imaging and Visualisation, both from UCL.

EngD Monitoring Research Study: a collaboration between UCL & Thameslink Programme

The EngD is an Engineering Doctorate programme promoted and partly funded by the ESPRC (Engineering and Physical Sciences Research Council). It is a four-year study which is undertaken with an EngD centre at a UK university in collaboration with an industrial sponsor. This study is being carried out at the Virtual Environments, Imaging and Visualisation (VEIV) centre at University College London, with the Thameslink Programme (TLP) at Network Rail as the industrial sponsor. The TLP is the £6bn upgrade of the railway line running north to south through central London (more information on TLP can be found in "Laser scanning on the Thameslink Project" in *Geomatics World July/August 2011 edition*). The research study is currently in its third year and is due to be completed in September 2014.

Tunnel Vision

A lightweight small 3D laser scanner has been helping Archaeologists in Derbyshire find what they believe to be is the world's oldest railway tunnel.

Earlier this year Wessex Archaeology was commissioned to undertake an archaeological evaluation and building survey on the former railway tunnel and line at Fritchley, Derbyshire, by the Derbyshire Archaeological Society.

The Society has long worked for the conservation of the more important sites and buildings in Derbyshire and is one of the major county bodies consulted by planning authorities on archaeological sites and historic building matters.

Over the years Derbyshire has provided a number of industrial milestones and most recently excavations uncovered the entrance of an 85ft tunnel, a section of the Butterly Gangroad believed to date back to 1793 to transport materials between local quarries and the Cromford Canal.

Chance discussion

The decision to re-open the tunnel and further investigate was the result of a chance discussion between a local landowner and a railway historian. Work has been funded by the Heritage Lottery Fund with desk-based research carried out by the Derbyshire Archaeological Society and Wessex Archaeology commissioned to undertake the fieldwork. The aim of the fieldwork was to investigate the date and type of construction of the tunnel and railway with a view to proving its antiquity.

Wessex Archaeology's Chris Breeden expounds, "Derbyshire Archaeological Society required us to produce plans, elevations, registered data and visualisations to show how this tunnel aligned with an earlier railway cutting. Any changes that we could pick up inside the tunnel relating to its fabric would ultimately allow us to date it. According to the Guinness Book of Records, the earliest rail tunnel was believed to have been built, again in Derbyshire, but two years later in 1795, so our discoveries could challenge that claim."

Risk of gas

The tunnel was subject to laser scanning and building inspection. A single trench to the south of the tunnel was also excavated to investigate the presumed original line of the railway. **Chris Breeden** is an experienced user of 3D laser scanners and immediately knew that it was the perfect tool for the job.

"We were after visualisations so 3D laser scanning was always going to be our first choice," explains Chris. "The laser scanner is extremely compact which was perfect for this job because the aperture of the tunnel was so small. On top of that, I was wearing a bulky protection suit and breathing apparatus in case of gas build up in the tunnel, so with seven or eight scan set-ups to carry out I needed to easily move the scanner around within the tunnel's tight confines. I also had only a couple of thirty minute tanks of air so the scanner's impressive speed of up to 976,000 points/sec was particularly useful. Additionally we chose the scanner for its integrated colour camera – photo-realistic 3D images can be created instantly – and because of its great performance in the low light which our halogens supplied."

The scanning work was carried out in a single day and the results quickly processed to illustrate that there were clear signs of joining fabric showing two phases of building. This was the evidence required to establish the tunnel's antiquity.

Chris concludes, "The scanner worked brilliantly with the deliverables clearly showing the evidence Derbyshire Archaeological Society had hoped for. The visualisations we created were spot on and later used for a TV report on ITV Central.

All images © Wessex Archaeology

Because of the danger of gas Breeden had to wear a bulky protection suit and breathing apparatus.

This project underlines the diversity of laser scanning applications and how the technology can often deliver quickly when other methods fall short.

Supplied by KOREC for this project, the new generation of 3D Faro laser scanners are compact and lightweight. They are a revolutionary but versatile tool applicable to a broad array of applications. In an age when clients demand more sophisticated 3D deliverables, laser scanners are earning their keep in the surveyor's tool box by proving to be an ideal solution to a range of projects, from straightforward building elevation surveys to complex monitoring jobs.

Unmanned Aircraft: – technology taking off

Over the next 8 pages Showcase present a series of articles and charts about unmanned aerial systems, otherwise known as UAVs or drones by the military. To get the feature off to a good start Richard Groom reports below on a conference at Newark on a windy day run by The Survey Association (TSA).

GERRY CORBETT is an ex Royal Navy pilot, turned air traffic controller who is now in Flight Operations Policy at the Civil Aviation Authority (CAA). He explained that the same principles apply to piloting of aircraft, whether they are manned or unmanned. Both have pilots, and have the same responsibilities, even if piloting the aircraft remotely. UA's range in size from hornet sized (16g) up to the size of an airliner but those currently used for surveying are all less than 7kg in weight, which puts them at the lower end of the lowest CAA category. In fact all the fixed-wing aircraft on display at the conference weighed less than 680g.

Certification

Unmanned aircraft can only be operated within line of sight, which is nominally 500m, and at an altitude of lower than 400 feet. The rules for UA operation in the UK are contained in the Air Navigation Order, of which articles 138, 166 and 167 apply. The purpose of the rules is to ensure the safety of third parties and there are a number of additional rules restricting where UAs can be used.

The CAA licenses UA operators via EuroUSC's BNUC-S qualification. The qualification is gained through attending a two day examined course which equips the operator with the knowledge to operate his aircraft safely. There are currently 180 licensed pilots and the number increases by around twenty per month. The licence is valid for a year, after which the operator has to undergo a refresher. The CAA encourages licensed pilots to contact them to discuss situations when they want to adapt and can justify adapting the rules for their particular use. For example, some conference delegates had been able to relax the maximum flying height and others, the maximum operating range from the pilot – by using spotters located so as to monitor the flight when it ventured further than 500m.

The latter relaxation would only be possible if the plane itself can operate safely at the proposed range and for this purpose the aircraft itself has to be certified with the CAA. **Tor Erik Djupos** (Ted) from Trimble's Gatewing UA manufacturer took delegates through type approval of the aircraft and the pilot certification process.

Inconsistent safety

Corbett was at pains to point out that the purpose of CAA regulation is safety, but this did not quite gel with the CAA policy of requiring only pilots of commercial aircraft to be licensed. Surely safety has the same importance whether you are a paid or an unpaid pilot. The point was made several times that incidents have to be avoided at all costs, or the future use of UAVs would be put in jeopardy. Although all operators record each flight, one did not get the impression that many, or indeed any, record near misses and minor

continued on page 14

incidents, or were aware that there is an established relationship between the frequency of near misses, injuries and fatalities.

Privacy issues

Safety is the main concern in the UK but in the USA the UA industry also has to contend with privacy. **John Palatiello** of the Management Association for Photogrammetric Professionals (MAPPS) (see *GW May / June 2013* p20) told delegates via a video presentation that privacy of the individual is an issue in the USA and guaranteed by the constitution. At present, two states have passed bills to prevent use of UAs for 'surveillance' but with specific exclusions to enable them to be used to take UA imagery for mapping purposes. But there is the ever-present possibility that aerial photographers will have to gain the permission of all land owners before taking photographs of their property, which would clearly render the technology unviable.

Choosing your UA and processing data

Fixed wing UAs are better suited to mapping projects while multicopters can carry a high quality camera and are controllable in narrow spaces, making them ideal for inspection work.

Christophe Strecha talked about Pix4D, a software that takes the mass of image data collected by the UA and turns it into orthoimagery and digital surface models. Pix4D is now available either via cloud-based processing or in a desktop version. Strecha drew a contrast between conventional photogrammetry, which uses precise, calibrated, large format photography with small overlaps, precise GNSS positioning and precise IMU data and photography taken with UAs, which uses uncalibrated cameras, small format photography with large overlaps, navigation grade GNSS positioning and less precise IMU data. Why does it work?

The answer is in the overlaps. By flying with 80% overlaps there is massive redundancy within the stereo imagery – effectively thousands of tie points on multiple overlaps, which means that the data itself can be used to calibrate the camera and carry out precise relative orientation. This just leaves exterior orientation, which can be achieved roughly using the aircraft GNSS positions measured during photography. For anything more accurate, ground control points are required.

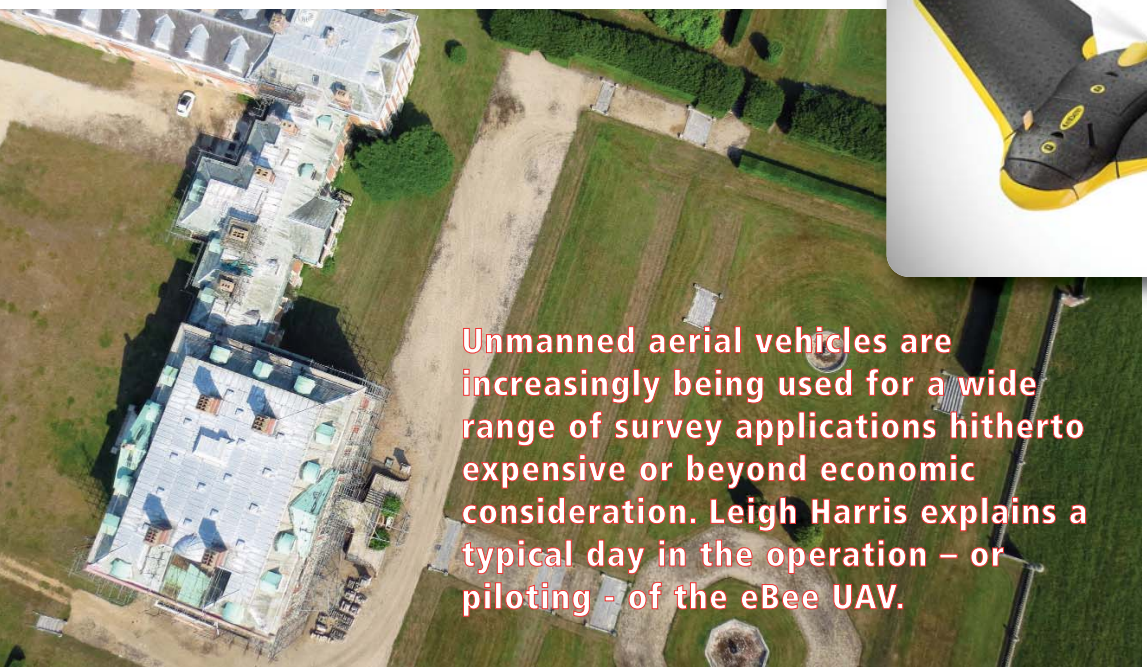
The process is an iterative one, in which the results from pixel matching are used to refine the position and orientation parameters for each photograph, as well as other unknowns – such as camera calibration. Finally, a point cloud can be produced, which can be draped with colour from the imagery. The accuracy of the results is not far removed from that obtainable from conventional photogrammetry. As a rule of thumb, the accuracy will be one to two times the ground sampled distance.

Against the wind

Flying conditions during the day were too windy for all but the Gatewing X100, and were even a bit marginal for that. But Trimble's Ted did a dynamic risk assessment and decided that flying was possible. The Gatewing was placed on its ramp and was duly launched, achieved a couple of runs and landed.

Ted talked about the data workflow and analysis of Gatewing data and gave the results of a test carried out on a site with lots of ground control. The result was an average positional error of 31mm with a maximum – on a relatively isolated point in the model – of 60mm. **Alan Cooper**, head of geomatics at Sky Futures spoke about how his company uses its three UAs – Gatewing, Aztec Falcon 8 and Aeryon Scout. They issue NOTAMS for all the surveys that they carry out and gave a rather alarming account of a survey in Wales when a low flying military aircraft crossed their site minutes before they had planned to take off. Clearly his NOTAMS had been ignored.

A day in the life of a civilian UAV pilot



Unmanned aerial vehicles are increasingly being used for a wide range of survey applications hitherto expensive or beyond economic consideration. Leigh Harris explains a typical day in the operation – or piloting - of the eBee UAV.

IT IS 3.45AM ON A TUESDAY and the alarm breaks my peaceful night's sleep. By 4.30 I am in the car. With my Satnav programmed, I start the long journey to Norfolk. I pick up my co-pilot who will help with support and driving during the day, in order to take some of the pressure off me.

KaarbonTech Surveying provides a UAV surveying service to the UK and around the world and my task for the day is to survey a country estate in order to produce a Digital Surface Model (DSM) and Orthomosaic. The DSM has to be accurate, so I will take ground control on the site using RTK GPS observations to ±20mm accuracy. I then need to perform multiple flights with the UAV to obtain enough photographs to produce a merged image of the 4 sq km estate. It's going to be a very long day.

I reach my first take-off location at 09:45am and start an on-site assessment. In addition to all the checks, I have also produced ground control points and landing/take off locations.

The GPS is unpacked and the antenna mounted on a 2m pole. While connecting to the network RTK service, I spray a cross on the ground that can be seen from the air. I observe the control point and jump back in the car. This is repeated for 20-30 points across the whole site.

Once the ground control is completed, I set-up a laptop and unpack the eBee. This is a crucial stage and it is imperative to check that each component is airworthy. The eBee is positioned ten metres away in order to pick-up its GPS signal. On the laptop, I start the control software and the drone appears on the screen located on a satellite image. Holding the eBee with two hands I shake the unit three times and the motor starts. After a careful look at the skies for other aircraft, I throw the eBee forwards and upwards.

The eBee flies effortlessly skywards to a height of 75m then measures the wind. It then starts its mission, climbing to 120m and heading towards waypoint one. Although the eBee is a fully autonomous device and will fly itself, I cannot pull out a chair and read the newspaper. My job as pilot is to monitor for any system warnings and for other aircraft. All the time the plane is in the air, I am scanning the skies for issues and looking at the laptop to ensure the eBee maintains its flight plan within 500m. The 500m rule is set by the CAA and ensures that the aircraft is always within my sight.

I can hear fast jets manoeuvring at high speed in the distance and this always raises my heartbeat. If a jet was to come into my airspace, I would need to be very quick in taking evasive action. Fortunately, good planning and communicating with other air users means this is seldom required. While flying, the control software makes a clicking sound every time a photograph is taken. This is very reassuring and gives me confidence that the flight is going well. A photograph is taken every 3-4 seconds and the pitch, yaw, roll and GPS information is logged for every photo.

Then I get my first error, a camera connection problem. Luckily this is rectified and we are back up in the air within an hour. It wouldn't be the first time surveying has been cancelled due to mechanical error! After 30 minutes flying, the mission is almost complete. As the eBee comes in to land, it reverses its thrust and glides to a halt in the grass about 12m away from me.

After every flight I process the flight data and geo-tag all the photographs. Only at this stage am I ready to move to location two. I continue this exercise throughout the whole day.

At 7.15pm I am in position on the edge of a field of crops ready to undertake my final flight. I am slightly concerned about the light, as the sun is making its way slowly down the sky but I gauge it is good enough to enable all the imagery to be uniform. The final flight is only short and after twenty minutes, the eBee returns to land.

Once all the data is copied, I pack everything back into the car and depart site at 8.30. At 9.00pm I check-in at the guesthouse. I have missed dinner but frankly, I am too tired to worry.

It has been an excellent day. Commercially flying UAVs is a rewarding job but it is not without a great deal of pressure and stress. The fact that I can complete a survey of a 4km site so quickly is truly remarkable.

It all starts all over again tomorrow, as I head off to North Wales for another survey.

About the author:
Leigh Harris is survey development manager for KaarbonTech and has been working in the mobile mapping industry for 18 years. He has been actively involved with surveying from selling high accuracy GNSS to performing highway surveys on motorways. Leigh jumped at the opportunity to work for KaarbonTech as it is a forward thinking company that thrives on the use of modern technology in all aspects of surveying.

Unmanned Aerial Vehicles: useable survey tools?

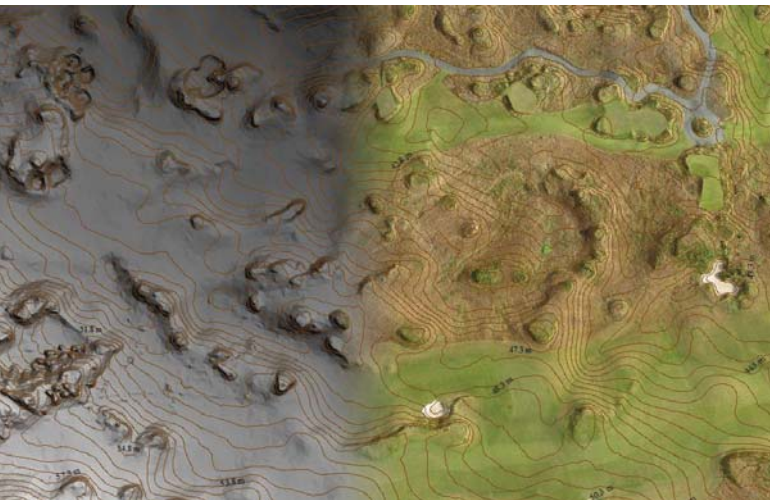
UAVs were developed for the military where they acquired the name, 'drones'. But recently the commercial sector has embraced the technology and experienced substantial growth particularly using micro UAS. UAV pilot Andrew Blogg explains the advantages and limitations.

UAVs were developed for the military where they acquired the name,'drones'. But recently the commercial sector has embraced the technology and experienced substantial growth particularly using micro UAS. Andrew Blogg, an experienced operator, explains the advantages and limitations.

There are many terms for unmanned systems but the definition is essentially the same: UAVs are capable of operating without an internal pilot; are tethered by a radio control link; and can be pre-programmed for both flight and payload operations prior to launch. They are most commonly referred to as Unmanned Aerial Vehicles (UAV) or Unmanned Aerial Systems (UAS).

This article focuses on the low weight, cost efficient end of the market, specifically 'Micro' UAS with a take-off weight less than 5kg, a flying height that should be less than 250m and flight duration of less than one hour.

Leaps forward in technology in the last decade have paved the way for commercial enterprises to develop sophisticated UAVs, predominantly to take aerial photography for use in mapping and for creating digital elevation models (DEMs). They are relatively easy to operate thanks to their on-board autopilots, intuitive flight planning and control software. They are safe, owing to their small payload and overall weight and many countries around the world are beginning to take notice of the commercial prospects for UAVs through regulation and legislation.



Used under the right conditions UAVs can capture high-resolution imagery suitable for photogrammetric analysis and extraction of height data. Above: An orthophoto "fade" image.

Choose the right platform

UAVs come in many guises, from helicopters, quad, hex and opti-copters to fixed wing plane-like systems. They all serve different purposes so, before spending your hard-earned cash on the latest opti-this or lightweight that, you must be clear about the purpose of its job.

Skill level, flight times, area, range, payload, wind speed, take-off and landing area, safety, vertical or oblique, video or photos are all factors to be carefully considered before making a decision. By way of a quick comparison, rotary types can generally offer better quality photos as they are capable of carrying higher payloads and therefore better quality cameras. Fixed wing UAVs, whilst offering lower payloads and lower camera quality, are capable of covering much greater areas and distances. So, for low level inspections or oblique photos, a copter is probably the choice. If larger scale ortho-rectified aerial photography is required, then a fixed-wing UAV might be more suitable. There are still many more factors to consider, but the choice should be made simpler if you understand your purpose.

Can UAVs compete?

Can a small UAV weighing less than 2kg using a consumer-grade camera and low-cost GNSS deliver results worthy of being used at a professional level? Traditional aerial mapping using a piloted aircraft will utilise expensive mounted and stabilised camera systems with equally expensive integrated Inertial Navigation Systems (INS). None of this is yet feasible at the micro UAV level. Micro UAVs are also much more sensitive to weather conditions. With little to stabilise the camera in windy conditions the pitch, roll and yaw can be greatly affected way beyond the level considered acceptable for photogrammetry. A consumer grade camera is also more susceptible to blurring during windy or low light conditions.

To compensate for the irregularity in the photos, most manufacturers of UAVs build in lots of overlap of photos, up to 60% laterally and 80% longitudinally. The obvious effect of this is greatly increased flight times to cover relatively small areas. While calibrating a camera for traditional photogrammetry is a must, it doesn't offer much in the world of consumer grade cameras. With their variable focal lengths and small moving parts, internal orientation values are too varied. Many UAVs now have built-in low cost GNSS, accelerometers and gyroscopes recording information, such as the photo centre coordinates, pitch, roll and yaw every time a photo is taken. Although the photo orientation information is not sufficiently accurate to control the photography it does help during the post-processing stages of mosaicing the images together.

Modern UAVs achieve much in compensating for the factors listed above, and do indeed deliver excellent results. UAV post-processing software company Pix4D say

5cm to 15cm accuracy can be achieved in relative terms. But, how can we deliver this kind of accuracy in both relative and absolute terms? From our experience, surveyed ground control points are a must in order to increase the accuracy. If we look at the on-board GNSS of many UAVs, they are capable of accuracies of no greater than 3m or so, which limits their inherent absolute accuracy. For volumetric work where height data is of the upmost importance, ground control points are crucial in getting the best possible absolute accuracies, making a simple survey much more time consuming.

The new Photogrammetry

The recent development of UAV technology has offered the geomatics industry a new commercial survey tool. But technology has really prospered in its ability to create full ortho-mosaic photos and DEMs without the need and skills of traditional photogrammetry. Software by companies such as EnsoMOSAIC or AgiSoft now have the ability to turn hundreds of images captured from a UAV into a 3D mapping product. In fact, some services are offered, by the likes of Pix4D, which entirely automate the process in a matter of hours. What this type of software really offers is a shift from traditional photogrammetry to a model that requires consumer level equipment.

A ground-based survey of a quarry could take several days but, depending on what accuracy you require, a 3D model of a quarry can be observed in a day using a UAV. Flight height, camera quality and capability of the UAV will affect the accuracies you might be able to achieve from this type of processing.

Using the Swinglet CAM UAV and 1cm GNSS, Digital Mapping and Surveys have conducted many tests to gain a good understanding of the accuracies achievable. We almost exclusively use GNSS ground control points in order to increase the absolute accuracy and obtain the best possible data. Points every few hundred metres are required to hold the accuracies to an acceptable level. Using locally installed software as opposed to an upload service gives us the flexibility to interrogate and check the data thoroughly. The result is an ortho-mosaic and DEM with an accuracy of around 5cm in x, y and z if flown below 80m with a 14 megapixel camera. The accuracy falls off with higher flying heights and with fewer ground control points.

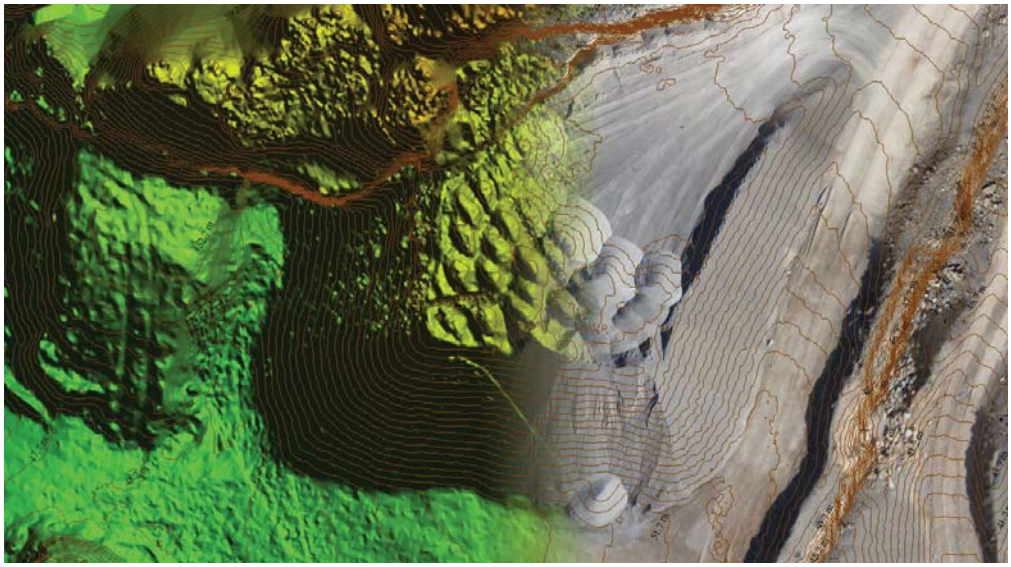
Locally installed software and processing hundreds of images has a downside – computer resources. Such methods are very memory and processor hungry so a computer to handle this will cost several thousand pounds, or be prepared to wait several days for a project to process.

Regulations

UAVs do offer a relatively low cost, practical way of obtaining high-resolution 3D data and ortho-mosaiced photos. But before heading out to fly over central London to capture some great images, beware of the Civil Aviation Authority (CAA) regulations in place for UAVs. In January 2010 the CAA introduced new regulations that require operators of UAVs for commercial purposes and those equipped for data acquisition to obtain permission from the CAA before commencing a flight within a congested area or in proximity to people or property. In order to fly in the UK, the operator (pilot) must pass a theory and flight test, specifically for light UAVs. A full list of the rules and regulations can be found in CAA publication CAP 393, section 166. Briefly, the main regulations for consideration are a height limit of 400ft (which affects the resolutions that UAVs can obtain), not to fly over or within congested areas and to fly no more than 500m from the operator or within line of sight.

The future

It is now possible to capture high-resolution aerial data much more readily and at a fraction of a cost of other methods currently available. Using a UAV, we have demonstrated accuracies very close to topographical survey standards. In fact, for many applications the use of UAVs has replaced the standard topographical survey method, particularly in quarries where an accuracy of 5cm is sufficient for calculating stocks. We mustn't dismiss the amount of input that is still required to generate the best quality data and safety standards. Human operators are required for take-off, landing and processing, and to be aware of the safety regulations that need to be in place to prevent accidents. Airspace is not a free for all, and regulations prevent us from surveying in many locations, putting many people off. But as the UAV industry continues to develop at pace, accuracies and capabilities will increase and UAVs will certainly become more and more prevalent in the geomatics industry.



A high resolution image captured by a UAV from which a contoured digital elevation model has been extracted.

ABOUT THE AUTHOR
Following an MSc in GIS and Remote Sensing Andrew Blogg has worked as a GIS consultant for several large companies including ADAS, Capita Symonds and KOREC. During his time at KOREC he introduced Sensefly's Swinglet CAM UAV to the UK market. Since then Andrew has started his own company using UAVs to provide an aerial data service in the UK.
Email: Andrew.*blogg@dmands.co.uk*
Web: *www.dmands.co.uk*

UAVs: SYSTEMS & DELIVERABLES








Manufacturer	Aibotix GmbH	Aibotix GmbH	QuestUAV Ltd	Rotomotion	senseFly	Trimble	Trimble
Model	X6	X6	Quest 200	10 Models Available	eBee	UX5	X100
Type	Hexacopter	Multicopter	Fixed Wing, EPP (High Impact) foam	Helicopter	Fixed Wing	Fixed Wing	Fixed Wing
Purchase cost	29000 euros	Pricing starts at 42,000 euros depending on configuration	c. £15,000 for full system	$15,900 to $200,000		POR	POR
Primary use	Inspection / Mapping / Geo	Inspection & mapping	High res ortho mapping and DEM generation	Inspection/mapping/other	Mapping (3D)	Inspection / mapping /	Inspection / mapping /
Weight without camera	2.555kg	2.555 kg	2.5 kg	From 2kg to 30 kg	0.545kg	~ 2.2 kg	~ 1.8 kg
Payload	2.5kg (higher on request)	2.50 kg	1kg	from 750 g to 40 kg	130-150g	~ 0.3 kg	~ 0.2 kg
Launch mechanism	from ground without ramp	autonomous or manual vertical take off	Bungee / Launch Line / Autolaunch	Auto take-off - no equipment necessary	Hand launch	Launcher	Launcher
Landing mechanism	from ground without ramp	fully autonomous (or manual), vertical landing	Belly land / autoland	eg glide / parachute	Very steep and precise autonomous landing	Glide, belly landing	Glide, belly landing
Wingspan	1,05m	1.05 m	2m	m	0.96m	1 m	1 m
Size of carrying case	103 x 110 x 43cm	103 x 110 x 43 cm	1.43 L x 0.43 W x 0.30 Ht m	Varies by model	0.55 x 0.25 x 0.45m (Fits IATA hand luggage regulation)	0.114 x 0.72 x 0.20 m	0.114 x 0.72 x 0.20 m
Average number of flights before replacement of aircraft body, under normal usage	n/a	Not available. Aircraft body is collision protected.	200 plus	1,000	About 200 flights	varies	varies
Cost of replacement aircraft body	n/a	21590 euros	Fuselage (inc.wiring loom): £895, Wingset: £495	From $5,000 to $30,000		POR	POR
Maximum operating speed (km/h)	60 km/h	60 km/h	104 kph (65 mph)	Upto 80 kph	90km/h	110 km/h	110 km/h
Maximum wind speed for flying operations (km/h)	45 km/h	45 km/h	64 kph (40 mph)	From 20 knots to 40 knots	45km/h	65 km/h	65 km/h
Power Source (eg: battery type / rechargeable / specialist)	Litium-Polymer 5.000 - 10.000 mA	Lithium-polymer 5,000 – 10,000 mA rechargeable	Lithium-polymer 5,000 – 10,000 mA rechargeable	Battery, gasoline, JetA	Lithium polymer battery	Lithium Polymer (rechargeable)	Lithium Polymer (rechargeable)
Maximum flight duration	30 min	30 min	70 mins	From 20 minutes to 6 hours	45min	50 min	45 min

Camera supplied with UA (make, model and MPx)		Customer provides. Recommended are: Nikon D5200, D3200, D800 for hi-res inspections. Nikon Coolpix A for hi-res mapping. Olympus Pen E-PL 5 14mm or 17mm lens for normal mapping. Canon 5D MK II and III for hi-res video. Sony NEX5/NEX7 for good quality video, Nikon V1 light weight video camera, GoPro HD Hero 3 black edition	Sony NEX 7 24mp with 16mm fixed lens (detachable)	Cameras are optional	Canon IXUS 127, 16MP	SONY Nex 5R - 16.1 Mpix	Rioch - 10 Mpix
Other camera models available	Yes	Yes	Yes. Lumix, Canon etc	We can customize UAV for virtually any camera which meets the weight limits of UAV selected	Canon S110	No	No
Other sensors available	Laser scanner	Infrared, Multispectral	RGB, IR, NDVI, Thermal, Air Quality	Virtually any sensor can be incorporated, depending on payload capacity of UAV selected.	Near infrared (NIR)	SONY Nex 5R Infrared	Rioch - Infrared
Recorded position of photo centres	Yes	precise GPS	navigation-grade GPS	navigation-grade GPS or precise GPS with optional GPS system	Navigation-grade GPS	Yes	Yes
Recorded tilts for each photo		MEMS	available, bot not needed with gimballed ssytem	MEMS	MEMS	Yes	Yes
Flight planning and control software	AiProFlight	Supplied within GPS Waypoint Navigation package	Skycircuits	Rotomotion proprietary software	eMotion 2, included with the UA	Trimble Access Aerial Imaging Module	Quickfield
Additional information (facts not covered elsewhere in table entry)		The Aibot X6 supports industrial inspection and aerial mapping applications. With its multi-rotor technology and a high degree of robotics, it is easy to fly or can execute a mission autonomously. Combined with a variety of plug-and-play sensors, the Aibot X6 goes where you cannot go or see.	QuestUAV 300 can carry multiple payloads or atmospheric sensors. Photogrammetry output is optimised for Agisoft Photoscan.	Rotomotion can integrate almost any type of sensor. UAVs are supplied as "base" model with a wide variety of payload options. The base system for each UAV is delivered as a complete, "ready-to-fly," fully autonomous system, exclusive of payload options.	• Very steep and precise landing • 3D flight planning • Multiple drones operation • Collision avoidance • Easy data management • Automatic safety features • 3D image processing software		
Supplier name (or logo)	KOREC	when it has to be right Leica Geosystems	QUESTUAV unmanned aircraft systems		senseFly	Trimble	Trimble
Contact name	Tobias Bleck	Mathias Motz	Nigel King	Dennis S. D'Annunzio			
Email address	tb@aibotix.com	mathias.motz@leica-geosystems.com	sales@questuav.co.uk	dsd@rotomotion.com	http://www.sensefly.com/about/where-to-buy.html		

UK-based companies offering a mapping service using UA aerial photography

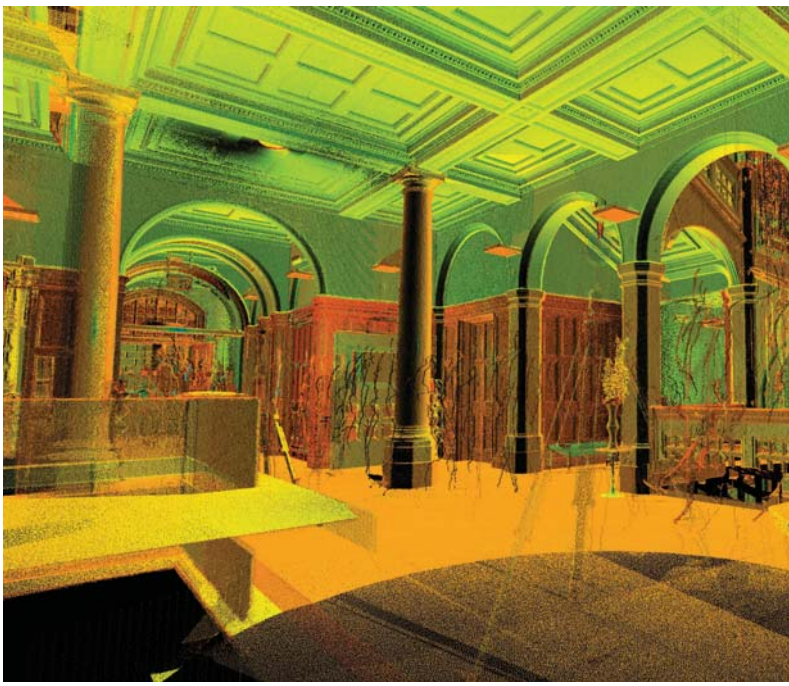
Logo	CYBERHAWK	DM&S Digital Mapping and Survey	exeGesIS Spatial Data Management	KaarbonTech SURVEYING	SUAVE AERIAL PHOTOGRAPHERS	
Company name	Cyberhawk Innovations Ltd	Digital Mapping and Survey	exeGesIS SDM Ltd	KaarbonTech	Suave Aerial Photographers	3D Engineering Surveys Ltd
Contact name	Stuart Thomas	Kevin Saunders / Andrew Blogg	Jon Young	Leigh Harris	Greg Colley	
Contact email	info@thecyberhawk.com	kevin.saunders@dmands.co.uk	jony@esdm.co.uk	sales@kaarbontech.co.uk	Greg@SuaveAirPhotos.co.uk	
Contact telephone	01506 592187	07765252915 / 07919898259	01874 711145	0800 804 8844	07842 766 679	
Base location	Edinburgh (Livingston), Reading, Aberdeen	Bristol	Brecon / Lincoln	Swindon & Bournemouth	Wigan (Near Manchester)	Winchester
Member of TSA?	No	No	No	No	No	No
No of qualified UA pilots	11	2	2	2	1-2	5
Highest qualification of permanent staff?	BEng, MSc, CEng, MBA	Masters GIS	PhD & / National UAS qualification	CCA qualified only	Fully CAA certified with Grandfather rights, also PPL	BNUC-S & RICS
List of UAs operated	Cyberhawk multi-rotor and fixed-wing vehicles	Swinglet, Ebee, Quest, Quad copter	Swinglet 16Mpixel (latest model)	Swinglet and eBee (Sensefly)	Helicopter style and Multi Rotor	Sensefly Ebee & Vulcan Mantis
Date began UA mapping	2008	Sept 2011	Nov-11	Nov-12	October, 2010	Apr-13
Inspection services?	Yes	Yes	Yes	Yes	Yes	Yes
Orthophotography and DSM service?	Yes	Yes	Yes	Yes	Yes	Yes
DTM service?	Yes	Yes	Yes	Yes	Yes	Yes
Other UA services offered?	Oblique aerial and panoramic images, route surveys, condition surveys, aerial thermal imagery, aerial HD video, live flare inspection (on and offshore), inspections of wind turbine and Met masts, transmission towers and chimney stacks.	Volumes and topo surveys, 3D visualisation, digitising	Advanced data processing and digital publication.	Post processing - Volumetric measurement, Topographical Drawings, Contours, Mastermap alignment, image improvement etc	Video, Other Photogrammetric, remote sensing	Complete mapping & Inspection Solution
Full survey report?	Yes	Yes	Yes	Yes	Yes	Yes
Additional information	CAA and IAA approved and worldwide insured. Over 5000 UAV flights to date. UAV surveys and inspections in Europe, Middle East and Asia. Largest commercial UAV service provider in Europe with 30 full time employees incl Land Surveyors and Inspection Engineers. Members of UAVS. FPAL and Achilles registered.	We are an experienced flying and survey/mapping company with vastly experienced and qualified people. The company has a proven track record of completing many UAV projects to an extremely high standard.. These include a wide variety of Mapping, Flying and GIS projects	exeGesIS is a respected spatial data capture and management company with 30+ staff and has been serving private, public and charitable sectors for 20 years. Our UAV service operates right across the UK and we have successfully completed hundreds of commercial flights for dozens of clients.	Experience in completing work for construction companies, National Trust, Aggregate Companies, Consultant planners, wind farms, Archeological companies	We can offer ultra hi ground resolutions of less than a millimetre, far, far higher than the 20-30mm resolution of other aerial mappers. We have been operating for a number of years now becoming expert in many areas. http://www.SuaveAirPhotos.co.uk	

Software for mapping from UA aerial photography

Logo / Image		APS Aerial Photo Survey	Trimble	Trimble		
Software Package Name	**ADAM 3DM Analyst Mine Mapping Suite**	**APS**	**Trimble Buisness Centre**	**Trimble Inpho**	**Agisoft PhotoScan Professional**	**EnsoMOSAIC UAV**
Software Company Name	ADAM Technology	Menci Software	Trimble	Trimble	AgiSoft LLC	MosaicMill Ltd
Produces Digital Surface Model and ortho imagery?	Yes	Yes	Yes	Yes	Yes	Yes
Time to process DSM of 100 models of 3cm resolution imagery with 80% overlap	~25 minutes, depending on computer performance	45 min			approx. 30 minutes	2 h
Produces Digital Terrain Model?	Yes	Yes	No	Yes	Yes	Yes, possibility to edit and monitor in 3D display
Produces full photogrammetric computation report?	Yes	Yes	Yes/No	Yes	Yes	Yes, txt file
Calibrates camera principal distance during processing?	Yes (optional; will report on claibration quality)	Yes	Yes	Yes	Yes	Yes
Calibrates camera lens distortions during processing?	Yes (optional; as above; report includes esimated parameter accuracy and correlations)	Yes		Yes	Calibrates radial and tangential lens distortions automatically	Yes, radial and tangential distortion, affinity and unorthogonality
Orientates photogrammetric models to 3D ground control pts?	Yes	Yes	Yes	Yes	Yes	Yes
Orientates photogrammetric models to plan only or height only ground control pts?	Yes; accuracies can be specified independently for each component	Yes	No	Yes	No	Yes
Software hosted on line?	No	No	No	No	No	No
User's recommended operating system and hardware specification	Win 7 64 bit or later, 3 GHz quad-core CPU, 8 Gb of RAM, NVIDIA or AMD discrete graphics card with 2+ GB video RAM.	windows s.o.	Win 7 and 8 (64-bit), Dual-core 1.80 GHz CPU, 2 Gb RAM, 5 Gb HD space DirectX 9 graphics card with 512 Mb memory		Windows/MacOS/Linux; CPU: Intel Core i7 3GHz or equivalent; 32 GB RAM	Win7 / Win8, Standard PC
Customer support?	ADAMcare Gold provides upgrades during support period, phone and email technical support, dongle insurance.	Yes	Trimble Distributor	Trimble / Trimble Disitributor	Free customer support included	any on-line device
One-off cost	Please contact manufacturer	4500 euro	POR	POR	3499 USD	starting from EUR 700
Annual maintenance cost	As above	500 euro	N/A	N/A	None	15%
Additional information	Can be used with digital camera and for aerial, terrestrial, underground and underwater.	Easy user interface, high quality results in automatic process. Free licence for trial	max 70 words		Free 30-day trial; Close-range imagery processing capability	Full photogrammetric suite, also corridor lines and rolling shutter or hyperspectral sensors.
Supplier Name	ADAM Technology	Menci Software	KOREC	Trimble	AgiSoft LLC	MosaicMill Ltd
Contact	Kevin Ha	Francesca Ceccaroni		Tor-Erik Djupos		
Email Address	adam@adamtech.com.au	francesca.ceccaroni@menci.com		tedtorerik_djupos@trimble.com		
Telephone	(61) 894795575	390575383960				

BIM at work

RICS (Royal Institution of Chartered Surveyors) is using building information modelling (BIM) on its London head office and plans to share its experiences with members and industry. **Les Pickford** talks to the main players involved and asks about the benefits and challenges.



Point cloud of the RICS main entrance

THE UK's *Government Construction Strategy* requires *"collaborative 3D BIM (with all project and asset information, documentation and data being electronic) on its projects by 2016"* and is part of the government's aim to reduce its construction costs by 20%. There is also increasing BIM activity in the private sector, propelled by an industry still trying to understand its impact on smaller projects, the supply chain and the wider property and construction world.

Given these drivers, RICS established an internal BIM group to improve its communications with its members and industry. At the same time, Severn Partnership offered to create a BIM model for the RICS head office at Parliament Square (PSQ).

"We wanted to use the PSQ BIM project to enhance our facilities management operation," says Matt McDermott, RICS sales and marketing director and catalyst for the BIM communications programme. "But we also wanted to help industry understand the challenges and benefits of a project, especially so that other occupiers of existing buildings can learn from our journey. If a client is undertaking refurbishments, I'd like surveyors to be able to discuss the benefits of BIM and have a compelling business case to add fee value.

"Severn volunteered to create a BIM model of PSQ because it is passionate about being RICS surveyors, this building and the BIM process," he adds. "It was a great opportunity for everyone."

What's the plan?

Severn has laser-scanned PSQ and is in the process of delivering a 3D BIM model to RICS, which it will help the organisation understand how to use. "But it's not just about the 3D model, it's about the information behind it and how everyone can share it and collaborate," says Mark King, 3D modelling project manager at Severn Partnership.

Future steps in the schedule include:

- helping RICS to choose appropriate software and hardware and to plan how the model will be populated, e.g. from data gathered through ongoing building maintenance
- training RICS facilities staff, and its refurbishment consultants and contractors, to use the model
- working with BCIS to include costs elements into the model. "We are lucky to have cost benchmarking experts working for us," says McDermott, "because not everyone has this resource."

It is clear that the RICS facilities team will have to change the way it operates. "It is learning as it's going along; it's not just about purchasing a 3D model and putting it into a facilities management system," King suggests. "Real success for RICS will be in its ability to communicate the pros, cons, pitfalls, benefits, and so on with others through conferences, training courses, white papers, etc."

What are the benefits?

Paul Chidgey, RICS head of facilities, has some initial thoughts on benefits, but admits that it is still early days. "I'm still not fully aware of everything that we'll get out of it, but we are learning. I'm sure other benefits will become clearer." For him the immediate ones include:

- using a 3D image to enable decision makers to understand how any major refurbishment will look
- potentially linking it with the RICS venues operation so people hiring a room can see 3D images of how it could look
- condensing information into one place. There are cupboards full of operation and maintenance manuals from the previous major refurbishment of PSQ, so information can be found if needed, but BIM means that it is all in one place.

King echoes this last point and says a big benefit to RICS is access to facilities management information. "We've probably all heard stories of a building being delivered to a client, which is then given a vanful of paper drawings and DVDs containing information that it doesn't know what to do with. Ultimately, most of it just gets left in its box and is never seen again."

BIM gives you information almost at your fingertips, explains King, and software is being developed that make these models very interactive and usable. "If RICS can get that information working for them, they will have something they've never had before in facilities management."

Existing buildings

But while BIM on newbuild projects gets a lot of attention, it should not be forgotten that existing buildings could also benefit.

"The advantage for the lay person is that they can see how changes to an existing building will impact their environment," says McDermott. "This can mean improved staff engagement and happier clients. A model can provide a centrepiece for better communications."

This focus on newbuild is probably because the tools have been developed with this in mind, says King. "They don't take into account Victorian or Georgian

Visualisation of the RICS library from building information model

"We wanted to help industry understand the challenges and benefits of a project, especially so other occupiers of existing buildings can learn from our journey"

architecture and things being curved or ornate. So it makes it a little more difficult to model an existing building." But because it is predicted that 60% of buildings today will exist in 2050, more will be refitted and refurbished rather than being newbuild, so BIM will increasingly be part of the process, he argues.

One of the main advantages for newbuild also applies to existing buildings – collaboration. "A 3D model allows you to collaborate with structural and mechanical and electrical (M&E) engineers," King says. "If you wanted to change all of the windows, for example, the model allows you to quickly create a windows schedule that can be used immediately by all parties." He adds that without the collaborative element of BIM, this process would probably mean architects and engineers annotating and emailing documents back and forth until a new specification is agreed, which could take weeks.

The PSQ survey

King says the process for surveying PSQ followed a standard route – with a measured building survey, a topographical survey, elevations, sections – but also created a 3D model with the ability to assign information to building elements. "Previously, we may have done a building survey, and took the elevations from a laser scan, but delivered only 5% of the information we captured. With BIM we're giving much more information to the client."

King advises that conducting a laser scan of an existing building presents specific challenges, including:

- a lot of information is not accessible, e.g. because services such as plumbing are behind walls
- the building is occupied and so it is often difficult to access certain areas, such as server rooms, due to confidentiality policies. It helped that RICS had CAD drawings to fill any gaps and facilities staff available to help with access and scheduling of room surveys to work around conferences, King says
- windows that do not open can prevent the laser scanning team from clearly seeing external control points used to ensure the accuracy of scans
- historic buildings tend to have smaller rooms with more corridors and doors to staircases. This makes the scanning process slightly more complex and time consuming, compared to modern buildings with more open floors, fewer walls and more columns
- clients often do not like any marks left in the occupied building. "If we return to a room, we'd like to use the same control points but we can't really mark the floor or walls as we can with industrial buildings," says King. "This is why we try to start and finish on known fixed coordinates and complete a room in a day."

However, while newbuilds allow models to be populated with manufacturer's product details, existing buildings (especially historic ones) could have elements that are hundreds of years old or of unknown origin, so model details have to be populated from scratch. "For example, when doing M&E modelling we can scan a pipe but we don't know what it's made from, what flows through it, where it comes from or where it goes to," warns King. "So we will add parameters to drop-down menus so an engineer can click on the pipe and complete the details of its use (e.g. gas, water or electrics) and what it is made from (e.g. steel, iron or plastic).

"Not many organisations can afford to immediately populate a new model for an existing building," King adds. "But through ongoing building maintenance, this can be done room by room, window by window, door by door. Soon, RICS could have a very information-rich model."

The challenges ahead

As you might expect, being at the start of this 'learning journey' means there are quite a few challenges in the months and years ahead. But what are the key ones?

Skills "We don't currently have the skills to truly realise the benefits of BIM," says McDermott. "Using a BIM model and squeezing value from it is something we haven't done before. So it's a massive step and we'll need training."

King agrees that there will be a learning curve and says: "Some people may not have worked in a 3D environment before and using vast amounts of information could be quite overwhelming."

However, the issue for Chidgey is that BIM skills are not inherent in his team's current working environment. "But I don't see it as solely a responsibility within facilities, I also see possible partnerships with contractors and consultants and to build this into our cost model. I need to ask whether we need these skills internally, with the required resource levels, or bring them in as needed."

Model use McDermott suggests there will also be a challenge because, generally, using the model will not be a daily process. "Populating the data won't happen until work is performed. As we're not completing the model during a big project, we may not get the enthusiasm and buy-in you would expect. But over the next few years there will be many smaller PSQ projects and this will improve as the model beds in."

Information technology "New hardware and software will probably be required, with all of the related training," says King. "Also, decisions will be needed about the IT

environment around the model, for example will the data be held internally or in the 'cloud' and what are the security requirements?"

Working practices Moving from a predominantly paper-based environment to an electronic one is likely to present the biggest challenge, advises King. "All organisations have people who will be adverse to change. So it's about managing them and getting their buy-in to this new way of working. You might have the budget to buy PCs and software, but it's the people who will ultimately make the project a success."

Chidgey says he also needs to find a balance between running the model and delivering a working building. "I probably won't get any thanks if I'm busily entering data to the system and we're not getting carpets cleaned or walls painted. It's hugely exciting and it's going to have some clear advantages, but we need to ensure there is an obvious cost benefit."

What's in it for you?

"BIM is here to stay and will affect many surveyors, especially quantity surveyors (QSs)," says McDermott. "Their core skillsets can transfer into BIM management activity and they can take advantage of the benefits that BIM offers. There is a massive challenge in really using BIM – the theory sounds great but the reality is hard so QSs can help make models and processes work well. Also, industry reports such as Egan and Latham all point towards collaboration, which is one of the key benefits of BIM." (See More information.)

King says that as BIM activity increases throughout the industry, surveyors are more likely to find it a requirement on projects, especially in the public sector. "But there's also a pull from private clients that can see the potential benefits. Main contractors need to use it for government work but the cost, time and quality advantages mean that they're increasingly looking to use BIM on all of their projects. This is filtering down through the supply chain. As BIM gathers speed, surveyors should get involved and demonstrate their knowledge, because this should lead to more work."

Implementing BIM on PSQ is clearly a huge task for RICS and will need decisions on everything from IT requirements and skills to working practices and data collection. "I hope that by sharing the lessons from this project our members will understand the challenges of actually developing a BIM model on an existing building," says McDermott, "and how to create the right working environment for its successful use."

The project team will be sharing its experiences through the RICS journals and updates on *rics.org/bim* and LinkedIn groups

RICS viewpoint

This article perfectly illustrates not only the cross-disciplinary nature of BIM, but also how close collaboration between professionals, especially different types of chartered surveyor, is the key to successfully understanding and integrating BIM. BIM has gained currency in newbuild projects, but has yet to really touch our vast portfolio of existing properties. This is an area of enormous potential for BIM adoption and for geomatics chartered surveyors, quantity surveyors, commercial property agents and others. Geomatics, data capture and building measurement technologies are the key to delivering a robust, fit-for-purpose and future-proof BIM model.

BIM, and its future integration with Geographic Information Systems (GIS), is about more than just buildings and, when combined with the future availability of 'big data', may revolutionise how we manage and evolve our cities and environments. However, BIM is only as good as the data within it. This is a fast-moving area and members should keep up to speed with new technologies, such as laser scanning, mobile scanning, software developments, cloud technologies, GIS and data standards.

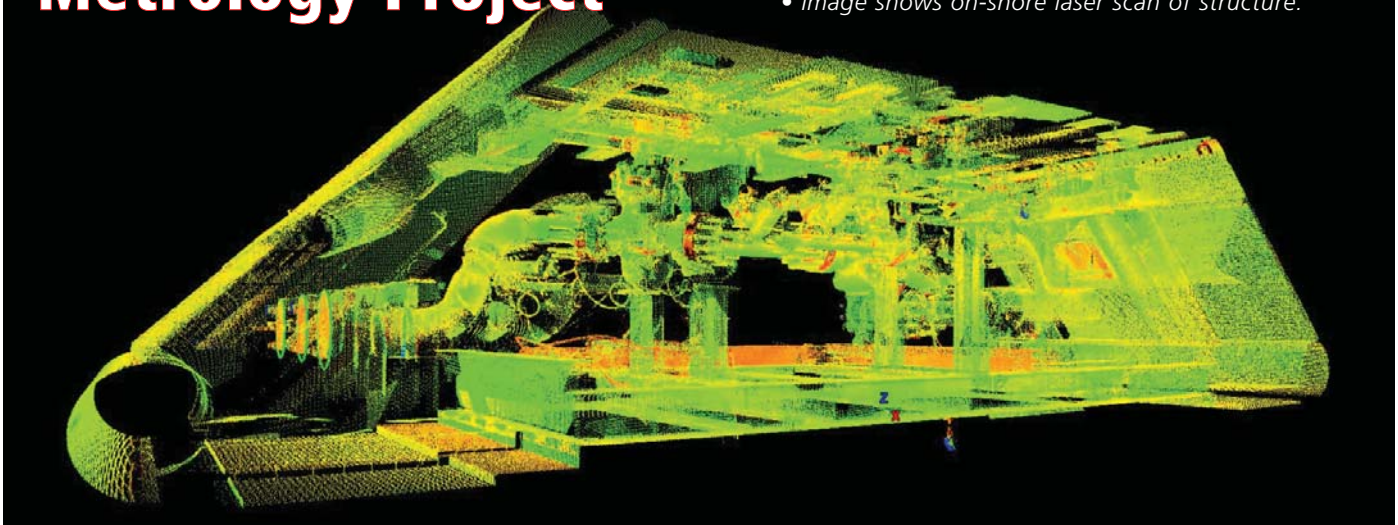
James Kavanagh MRICS, Director, RICS Land Group *jkavanagh@rics.org*

More information

Government Construction Strategy
bit.ly/12ueWFu
Sir John Egan's 1998 report *Rethinking construction*
bit.ly/LVyb4k
Sir Michael Latham's 1994 report *Constructing the team*
bit.ly/mjcgyv
For library resources, search for 'BIM' at *www.rics.org/catalogue*

About the author
Les Pickford is a freelance writer and former Editor of the RICS Construction Journal
lespickford@yahoo.co.uk

Laser scanning and sonar combined: the Talisman Auk North Spool Piece Metrology Project



• *Image shows on-shore laser scan of structure.*

An ingenious combination of laser scanning and multibeam sonar for a project in the North Sea won its developers a top Innovation Award from Leica Geosystems. **Greg Hammond** of UTEC StarNet explains.

IN DECEMBER 2011, StarNet Geomatics (now UTEC StarNet) was engaged by Talisman Energy to undertake a subsea survey to determine the precise dimensional relationship between flanges on two existing pipe manifolds on the sea floor. The survey was needed to enable a spool piece to be fabricated to fit between the two manifolds.

A sea / land partnership

The practice of laser scanning is becoming increasingly common within the offshore industry with operators such as BP and Talisman Energy adopting them as standard, but precise sonar scanning is new. In partnership with BlueView Technologies and Seatronics, Star Net pioneered a unique solution using a combination of high-resolution terrestrial data acquired from an HDS6100 laser scanner, together with high frequency multi-beam sonar data acquired by a Blue View BV5000 system.

Over the previous 12 months Star Net had been engaged with Technip UK, through a series of dry dock trials, in developing and improving the accuracy of the BlueView sonar system to provide a viable solution for spool piece metrology. For each trial. the project utilised high resolution terrestrial laser scanning technology to generate a precise point cloud against which the sonar data was compared. This then drove improvements to the system for the next trial in the series. New processing techniques, coupled with improved hardware and targeting systems were developed to achieve tolerances of less than 100mm and better than 1° inclination over a 30m baseline.

This approach of utilising purely high resolution BlueView sonar data to derive spool piece metrology results was successfully implemented on four subsequent surveys. The results were verified by comparison with data generated from traditional Long Baseline Line (LBL) acoustic metrology techniques, using transponders on the sea floor for control.

Enhancing laser scanning

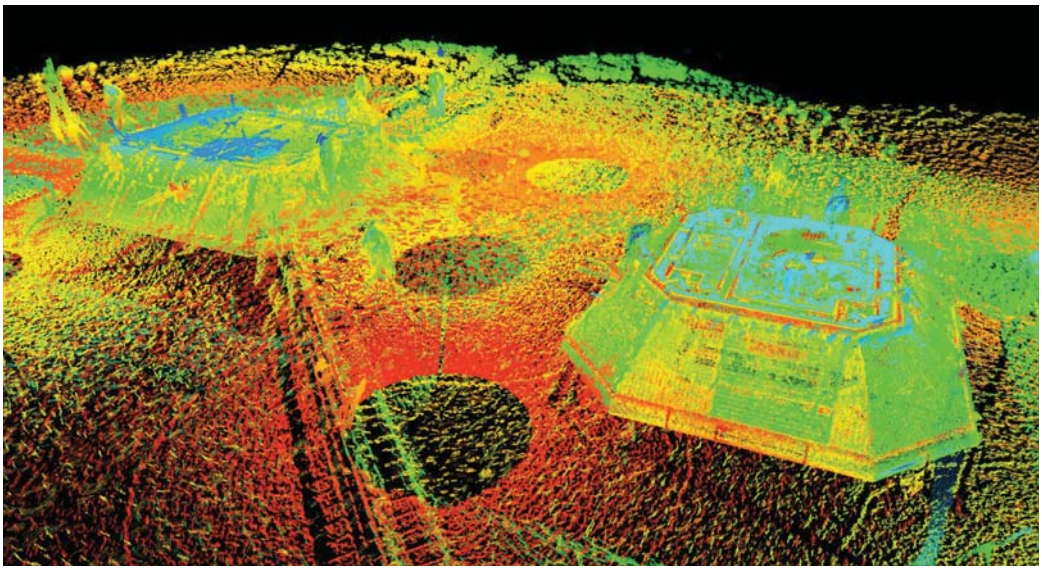
One of the subsequent projects was the task for Talisman Energy that won the Leica 2012 HDS Innovation Award. In this case, a previous laser-scan survey by Star Net provided an opportunity to enhance the sonar data thus improving accuracies and establishing a better overall workflow. For dimensional control purposes, Star Net had laser-scanned the existing subsea manifold when it was in the fabrication yard many years earlier. The use of this dataset allowed them to simulate metrology results on the subsea structure and for the installation contractor to retrospectively design acoustic metrology aid brackets which were to be added to the existing structure. The second manifold structure was subsequently also laser-scanned to provide a similar dataset, complete with acoustic metrology aids.

Due to the complex nature of the project, the traditional LBL acoustic solution contained inherent risks, thus an independent verification was required using BlueView technology. The access panel to the flange face of the existing structure was not to be removed as part of the operations, so the flanges could not be scanned directly. It was therefore decided to import the highly detailed and accurate terrestrial data into the BlueView sonar point cloud to provide a composite dataset with exact positions of the points of interest. The sonar data would provide a roadmap for both position and inclination which the terrestrial data would then utilise. The final metrology computation would then be derived from the merged dataset.

Static multibeam datasets

The deployment and

operation of the BlueView sonar was planned and executed in a similar fashion to that of a terrestrial laser scanner. The sensor was deployed from the vessel on a mechanical winch through a moon pool to observe a total of sixteen setups in an eight and a half hour programme. An ROV observed the touchdown on the seabed and intervened as required. The resultant, individual, XYZ files were uploaded into Leica Cyclone and registered together. The terrestrial laser data was introduced as part of the same registration file, utilising main structural members for cloud-to-cloud registration of the multiple datasets.



Above: *Merged seabed sonar and laser scan data (see two manifold covers).*

... and it fitted!

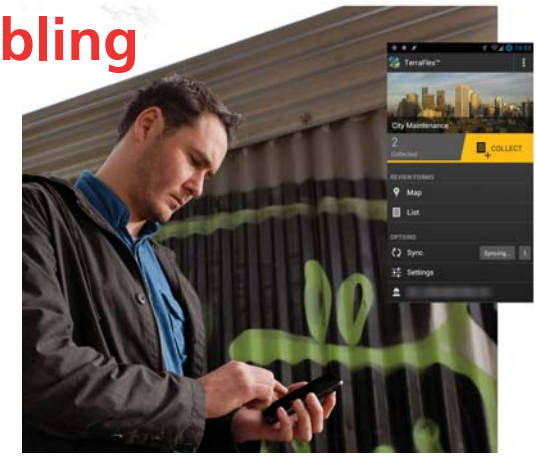
The introduction of the terrestrial laser-scan data to enhance the overall solution was a ground-breaking approach, piggybacked onto a unique subsea survey solution. The project was the culmination of months of planning and proved to be very successful, with a horizontal error difference of only 14mm between the laser scanned and the acoustic result. Most importantly though, the spool fitted first time.

The use of this survey approach has been adopted by numerous oil companies following this project and provides another tool for operators facing difficult situations where surveying using Long Baseline Line (LBL) techniques cannot provide the required results.

As **Pieter Jansen**, senior survey representative, consulting to Talisman Energy UK Ltd. says: "No doubt contractors will look at this solution with interest, as it provides a very precise and efficient method for obtaining metrology data in challenging operational conditions."

Software: the brains behind the bling

Other professionals may cast envious eyes on the flashy electronic toys used surveyors and engineers but the data collectors all need evermore clever software, explains Richard Groom, to convert data into actionable information.



Trimble's Terraflex is cloud based and runs on Win mobile, Android and iOS devices.

TO THE OUTSIDER, the instrumentation that surveyors use to collect data is sexy. It's shiny, bright and a toy that everyone wants to play with. It's even more impressive when it rotates and nods all on its own. Everyone wants to play with our toys, but only yesterday I came across an instance where non-surveyors had collected sounding data using a remote-controlled boat fitted with a Garmin GPS receiver, but clearly did not understand the data they had collected or know what they would do with it, having gathered it!

The truth is, of course, that data processing is the brains behind the bling and software plays a vital part in ensuring that it is processed efficiently and correctly, stored methodically and presented professionally. In this issue of *Showcase*, a dozen software houses describe their wares. A comparison with last year's reveals gradual change rather than revolution.

From total station to laser scanner

The function of surveying software is twofold. First to convert survey observations into coordinates and secondly to turn the coordinated data into intelligent features. Several popular software packages have been around for many years. They started life as processors of feature-coded total station data. They developed into sophisticated ground modelling and mapping packages and then, in response to the market, into specialist areas such as roads, railways, shallow hydrography and setting out. We also see these packages to take the data processing function into the field with software that converts digits into graphics on ever more powerful data loggers.

As well as processing total station data, the long-established packages now accept data observed with other equipment, such as GNSS and laser scanners, which has been pre-processed using other software to turn the raw observations into coordinates. Point cloud processors, such as Leica's **Cyclone** and LFM's software carry out this processing and registration function. The natural development of these packages has taken them into modelling as a means of creating intelligent features from the mass of points.

Specialist apps

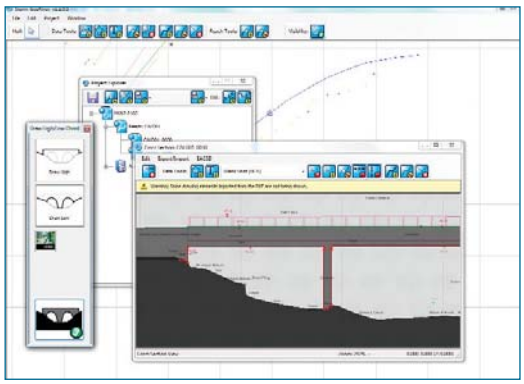
A third category of surveying software is focused on particular application areas such as **MBS Floor Plans** for measured building surveys and MBS RXS and **Storm GeoRiver** for dimensional surveys of river channels.

This year's list includes two newcomers, **Cardinal Systems**, which offers software to combine LiDAR and photogrammetric data and **Microsurvey**, through UK supplier, South Survey Ltd, which now includes the STAR*NET network adjustment software.

Point clouds are one current trend, with some packages supporting the import and display of registered point clouds. Indeed, Atlas Computers's **Survey Control Centre** can now support 4 billion points and also includes automatic extraction of edges. Elsewhere in this issue we have covered software for processing photogrammetric point clouds and no doubt it will not be long before these dense point clouds will find their way into mainstream survey software.

Machine control is another area of development and McCarthy Taylor Systems' **LSS** has responded by being able to export complete formation-level model data to machine control systems. LSS also offers licensing on an annual basis, rather than one-off payment and annual maintenance. It is certainly a bold policy, which forces the company to work for customer loyalty.

Finally, what about the cloud: the 'online cloud'? It is increasingly seen as a good place for data; **Trimble TerraFlex** and Topocad both use it for this purpose as does Topcon's **Magnet** software. LFM uses the cloud for collaborative working. Storm GeoRiver uses it for software licensing. Other software uses it to batch-process photogrammetric data from unmanned aircraft (UAs).



Storm Geomatics' GeoRiver is cloud licensed for river channel survey processing.

The following are companies who responded to our request for statements about their software. If we missed you, apologies. Drop us an email and we'll get you in next time.

Applications in CADD

Applications in CADD Ltd (AiC) is one of the UK's leading suppliers of Mapping & Modelling, Design and Data Capture software, with innovative products n4ce and 4Site.

n4ce provides "Field to Finish" model and CAD solutions. From data processing using least squares network adjustments, to feature and model creation using coded points to final presentation drawings. For more advanced users applications are available for river & rail surveys, geological modelling and alignments. A project tree allows viewing and access to various data types stored in projects, with ripple-through effects, dual editing in both sheets and graphics views, backcloths and hot key interaction. Add ease of use and you have a powerful solution to meet your needs and budget. A true geomatics software toolbox!

4Site is for the field engineer or surveyor who needs to capture and process data directly into a DWG drawing format, using a total station or GNNS receiver as a digitiser. A Code Table converts survey measurements into CAD detail, which appears in front of your very eyes! Setting out is simplified as working drawings can be taken into the field. Specialist applications are available for Hydrographic, Rail and Building Surveys. n4ce and 4Site store data in a single unified environment with automatic backups for those occasions when things go wrong.

Contact:
Dr John Strodachs, Applications in CADD Ltd
21 Britannia Street, Shepshed, Leicestershire LE129AE United Kingdom
t: +44 (0)1509 504501 f: +44 (0)1509 600079
e: **enquiries@appsincadd.co.uk** w: **www.appsincadd.co.uk**

Cadcorp

CAD software and GIS software were developed as solutions to different problems. CAD software was developed for the design of man-made structures that had yet to be built. GIS by contrast was developed primarily to represent existing phenomena, both natural and artificial.

As Building Information Modelling (BIM) is becoming more prevalent throughout the construction industry, the sharing of digital information is greater now than ever before. The challenge is how to share data when systems differ in terms of data model, data format, coordinate system, and attribution levels. The AEC profession has traditionally shared information by exchanging files amongst the individuals and the systems involved in a particular project. The trend is to move to server-based data sharing, based on repositories of data that can support multiple users, multiple systems, and multiple projects.

The Cadcorp Spatial Information System® meets the needs of both current and future working practices as it supports both the file and server-based exchange of spatial data.

In addition to the ability to read over 160 different CAD and GIS file, database and image formats natively without translation, our desktop software includes an easy-to-use DXF Exporter tool at no extra charge. This allows CAD users to quickly and easily extract OS MasterMap® and other business data from the organisation's spatial data store for use in their CAD software.

More information at:
http://www.cadcorp.com/industry/architecture_engineering_construction.htm

Cardinal Systems

Cardinal Systems offers **Vr Mapping**, the result of over 25 years of development, which includes a variety of software modules for use in the mapping community. Its flagship program, **VrOne®**, is a powerful mapping, vector collection and editing system with digital terrain modelling, batch processing, image handling, data translations and application overlaying. Other features are on-demand autocorrelation, DTM processing and image manipulation such as sampling, tonal balancing, splicing, feathering, simple rectification and orthophoto generation.

VrLiDAR is the newest product and integrates LiDAR into Vr Mapping software. This package allows the display and editing of LiDAR point data in 2D and in true three-dimensional stereo. The four configurations available in VrLiDAR enable vector entities to be collected and edited using the extensive **VrOne/VrTwo** mapping tools. Within the 3D ViewPoint environment, this vector data can be collected and edited over raw point clouds.

Our products currently include VrOne, VrTwo, VrLiDAR, VrOrtho, VrMosaic, VrBalance, VrAirTrig, VrAdjust, VrVolumes and VrLite. We offer in-depth, comprehensive training in your offices or at our training facility in Florida and provide prompt and thorough support services.

Contact
Cardinal Systems, LLC701 N Oceanshore BlvdFlagler Beach, FL 32136-3309Phone: (386) 439-2525Fax: (386) 439-0259
e: **info@cardinalsystems.net** w: **http://www.cardinalsystems.net**

Carlson Software

Celebrating its 30th year in 2013, Carlson Software specializes in CAD design software, field data collection, survey, and machine control products. Industries using the software include land surveying, civil engineering, construction, and mining worldwide, providing one-source technology solutions from data collection to design to construction. Carlson Software's renowned dedication to customer service is unique in the industry.

Our Mission is to be the premiere independent developer of land surveying, civil engineering, construction and mining technology products.

- To maintain our reputation for technological innovation.
- To provide industry-leading customer service and support.
- To provide one-source technology solutions from data collection to design on through to construction.

Developing user-friendly, technically advanced software for land surveying "doing what surveyors needed it to do" is how Carlson Software got its start. By encouraging a customer feedback Carlson gets invaluable data that is used to develop annual releases always chock-full of customer-driven new features.

In 2014 new versions of Carlson data collection products SurvCE and SurvPC have been released including a feature that uses the cloud to allow field staff to communicate with other surveyors, the office and exchange data. Also released in 2013 is a new version of the Survey processing and Civil design suite that includes even more powerful functions, that save you both time and money at a price you can afford.

All products are available as fully functioning demonstration versions.

Contact
David Loescher, UK & Ireland sales director
e: dloescher@carlson.com w: http://www.carlsonemea.com/index.php/en/

Leica Geosystems

With easy data processing and a seamless workflow for fast, reliable results, Leica Geosystems announces **Leica Infinity**, the office software for easy management, visualization, processing and georeferencing of combined total station, imaging and scanning data from the Leica **Nova MS50 MultiStation**. Part of an extensive portfolio of software that com-pletes the Leica Nova solution, Leica Infinity provides users with custom deliverables and helps them make informed decisions.

With a simple user interface, optimized data organization and dynamic data visualization, Leica Infinity gives a perfect project overview and ensures streamlined workflows. Scan data can be inspected, cleaned up automatically to remove outliers and re-calculated together with the total station set-ups. Multiple scans can be combined for the creation of information-rich surfaces.

The instant access to raw data at all times allows users to combine and cross-check scans against processed or archived data and survey results with only a couple of clicks in order to make the right decisions. **Leica Infinity** offers all the tools to document and report on individual steps and final results before data can be exported for further processing to a broad choice of CAD software packages.

Contact:
Leica Geosystems - Part of Hexagon
Davy Avenue, Knowlhill , MK5 8LB Milton Keynes, United Kingdom
t: +44 (0) 1908 256 547 e: **linda.schmidt@leica-geosystems.com**
w: **http://www.leica-geosystems.co.uk** *or* **myWorld @ Leica Geosystems**

LFM Software Ltd

LFM is a powerful 3D laser scanning software package, which is relevant

throughout the laser data and asset lifecycle. LFM is hardware and software vendor neutral. It accepts data from all 3D laser scanners and exports to 3D integrated plant design systems CAD and Review platforms.

LFM's philosophy lies on two main principles:

- open system, without restrictions. LFM aims to be neutral at both ends: neutral with respect to capture devices, and neutral with respect to CAD and modelling technologies. Only one software solution is required even when there are multiple hardware systems.
- Relevant throughout the entire plant lifecycle. LFM software allows seamless use of the data from capture, to initial processing, and registration, through to final delivery to the client.

The LFM software suite includes LFM Server enables users to access and work with preregistered 3D laser-scan data from any scanner vendor, to clash detect a proposed design against as-built data, and to interface with CAD packages from AVEVA, Autodesk, Bentley or Intergraph. LFM Server in Gateway mode offers unparalleled connectivity to terrestrial 3D scanners. It can also import other types of data from mobile, hand-held or aerial scanners and enables data export in open, industry-standard formats.

LFM Modeller enables users to produce intelligent 3D models from as-built laser-scan data with only a few clicks, and to export the models into a wide range of 3D CAD systems.

LFM NetView enables users to securely access remote 3D laser-scan data. More than an online viewing package, it provides tools that enable users to work collaboratively with laser-scan data over the Internet. LFM NetView is innovative in its approach to sharing 3D laser-scan data online, as it connects back to the master LFM Server dataset. This ensures that the full resolution of 3D laser-scan data is available to the remote user, avoiding any loss of resolution incurred by the transfer of compressed data over the Internet.

Contact:
LFM Software Ltd, 5 Avocado Court, Commerce Way
Trafford Park, Manchester M17 1HW, UK
t: +44 (0) 161 869 0450 f: +44 (0) 161 869 0451
e: **Matt.wren@aveva.com** w: **www.lfm-software.com**

LSS

LSS, now in its 29th year of success offers the user a no-nonsense solution to topographical surveying. LSS is a land survey processing and digital terrain modelling package which will read data from virtually all survey instruments to create a fully editable and contoured plan on screen with user-definable symbols and line types, annotation and comprehensive quality assurance. If your data comes from sources other than survey equipment then LSS will import data from DXF, GENIO, CSV, LandXML and others. There are three LSS products, LSS Solo, Vista and Elite. All users pay is an annual licence fee which includes technical support and software updates. Many survey users start off with LSS Solo and upgrade to a higher, more feature-rich version at a later date and all they pay is the difference in annual fee (pro-rata'd if part way through the year). Because the software uses a USB dongle, it means that it can be installed on several computers and the dongle moved or shared across a network. For those who would like training, we hold courses once a month at our offices, plus week long events at various locations throughout the UK every year. Online discounts are available for software and training bundles.

LSS Solo will download from and upload to EDM and GPS equipment (including Leica, Trimble, Topcon, Sokkia, Nikon etc), produce a 3D contoured survey or building elevation and efficient editing of levels, line styles, annotation and the addition of points via a set of quality-assured CAD-Pro commands. It will handle 2D, crossing links and non-terrain data too. It will then export the finished plan back to the survey instrument, AutoCAD in either 3D or 2D, MX as a GENIO file or LandXML. £250 a year.

LSS Vista includes everything in Solo as well as plan plotting, volumes between models, sections, design, even export to machine control systems (export the complete formation-level model), DTMs from Pointcloud data, rail overlap adjustment, gauge reporting, virtual tours and more. LSS 3D Vantage. £500 a year.

LSS Elite is in use across a wide range of industries. A comprehensive range of advanced volume options, isopachytes, plus slope and earthworks designs, restoration and topsoil stripping, tools for the

creation of restoration models, line of sight and visibility analysis (ZVI and ZTV). Add to this list everything in Solo and Vista and they combine to make Elite a package used by many of the leading civil engineering, construction, consultancy, mineral extraction, landscape architecture and engineering surveying organisations in the UK. £750 a year.

Education for teaching and non-commercial research use. £250 a year for a ten-user network system (including dongle).

PASSPORT for non-commercial collision investigation. The package includes our top Elite system and inclusive training tokens so new team members can get trained-up in no time at all.

Contact:
McCarthy Taylor Systems Ltd, Aerial View, Acorn House, Shab Hill, Birdlip, Gloucestershire GL4 8JX
t: 01452 864244 e: **sales@dtmsoftware.com** w: **www.dtmsoftware.com**

MBS

MBS Survey Software Ltd is an independent software house providing solutions for the built environment. We have over 400 users benefiting from the continued development of our building, hydrographic and Rights of Light software packages. Uniquely, the software is developed by leading practitioners which means it is thoroughly tested on real jobs. You can be confident that the software meets the critical requirements for quick and cost efficient surveying for both the practicing measurement professional surveyor.

MBS Floor Plans allows for real time graphical capture of all the elements required for the production of scale drawings of floor plans. By running on Windows tablet PCs, the surveyor can input spatial data directly from a Total Station, a hand held laser measuring device or a steel tape.

MBS Elevations enables the surveyor to survey building elevations with a reflectorless Total Station and view the resultant elevation graphically as it is being measured.

MBS RXS Tools is a 3D modelling application for the processing on river channel surveys. Written within AutoCAD, this suite of tools enables processing, manipulation, editing and presenting of data usually required for inshore hydrographic surveys, with all major hydrographic exports supported.

MBS Waldram Tools Ranginui is a specific suite of tools designed to deal with the common daylight/sunlight issues highlighted as part of the planning process and the less common issues surrounding Rights of Light.

Contact:
MBS Survey Software Ltd
27 Old Gloucester Street
London WC1N 3AX
t: 020 7404 9029 e: **derry@surveymbs.com** w: **www.surveymbs.com**

NRG

NRG has been developed in the UK by practising engineering surveyors for over 20 years. A number of specialist add-on modules are also available as well as CoGeo, a low cost group of tools, which includes over 32 functions such as traverse adjustment, least squares adjustment and a digital level book from £99.

DTM / Map: a versatile survey processing and ground modelling package, it works entirely with raw survey data processing 'on the fly'. It allows input of borehole information and models the substrata. It takes design data from a host of sources and not only calculates volumes but will separate materials and measurement items, calculate benching etc. and produce detailed schedules to MMHW & CESMM

Render: a standalone rendering module that will produce driv-throughs and fly-overs. It shares the code library with DTM Map but uses the photo images for line and point styles and surfaces, giving the user an easy route to developing stunning visualisations for both surveys and proposed developments.

Cross Sections: developed initially for calculating volumes by cross section, this module provides the storage, editing and printing of cross sections along with area calculations and volumes. Unique to NRG is its ability to combine unlimited surfaces and 'dip' files making it ideal for roadworks and railways.

Design: Alignment design, supporting data from a wide range of sources, easily attaching road or railway details to create digital models, cross sections and setting out information.

Drainage: a contractor's package for taking off materials, supervising construction and measuring to the method of measurement. It includes several functions such as clash detection which make it an essential tool for drainage contractors. It works seamlessly with DTM Map and design giving the user fast analysis of 'what if' scenarios as well as tracking the as-built.

Monitoring: a real-time monitoring package, designed to collect spatial data from a range of sources, including survey instruments controlled over RS232 or web-based links. A wide range of visualisation tools are included as well as customisable control over the reporting, prediction and warning functions of the system.

Tunnelling: a volume and 'wriggle' package, developed to check the clearances of an as-built tunnel, by whatever method, bore or blast, it can cater for complex shapes, even allow for a series of headings or benches at the same time. Overbreak and underbreak calculations are presented in easily auditable cross sectional format.

Contact:
NRG Surveys Ltd, Castle View, Station Road, Llanfairfechan, Conwy North Wales LL33 0AN
t: 01248 681240 e: ***sales@nrgsurveys.co.uk*** w: ***www.nrgsurveys.co.uk***

SCC - Atlas Computers

SCC is a geomatics package in its third decade of continuous development. Native 32-bit and 64-bit versions and multi-core optimisation make best use of modern computers and surveying equipment to give your company the competitive edge. Solutions include:

PointCloud: Viewing, edit, and analyse point clouds of up to 4 billion points in real time. Automatically extract high quality line work for plans and elevations, sections. Compute volumes direct from the cloud. Trace features using a range of methods, and much more. Input from a wide range of formats, including Leica MS50 Scanstation.

Rail: Cant and gauge checking, string overlap comparisons, formation adjustment, wriggle surveys, lift and slue computation, and integration with Amberg trolleys and scanlaser machine control.

Rivers and water: Rapid processing of river surveys with output to all major formats. Canal processing for BW-MOC software. Flow line computation with confluence counting and annotation, beach surveys using vehicle-mounted GPS.

Design: Horizontal and vertical alignments, with templates to create surfaces. Support for multiple surfaces, widening, and interfacing

between surfaces. Polygonal design with cut & fill balancing.

Sections & volumes: Multi-surface cross sections, profiles, parallel sections. Cut and paste between plan and section. Volumes by areas and ground types, using isopachytes, grids and sections.

Survey & adjustment: Download from any total station, scanner, GPS and levels. Create and edit contoured models and maps. Least squares analysis. Geodetic and local transformations. Output to CAD (DWG, DGN and DXF formats), MX/MOSS, Civil 3D, 3D studio, GIS (shape files), LandXML.

Visualisation: 3D viewer with an extensive library of common 3D objects and road markings, direct output to Google Earth.

Free trial version available.

Contact:
Atlas Computers Ltd, 15 Moyville Lawns, Taylors Lane, Rathfarnham, Dublin 16, Republic of Ireland
t (ireland): +353 (0) 1 4958714/5/6 e: **sales@atlascomputers.ie**
t (UK):01480 404888 e: **sccs@sccssurvey.co.uk** w: **www.atlascomputers.ie**

South Survey Ltd, official UK suppliers of Microsurvey Software

Microsurvey have more than twenty years of developing complete CAD design software solutions for surveying, mapping, construction professionals, land surveyors, and civil engineers using total stations, GPS, and data collectors. Using their desktop and handheld software will increase efficiency and productivity.

They offer the complete software package from the standard CAD design software, to on-site land surveying software, to data transfer and sharing solutions to managing LiDAR datasets with ease.

FieldGenius gives you a competitive advantage in the field. Some of our customers have reported up to a 30% reduction in the time it takes them to complete a job because of the advantages FieldGenius offers.

MicroSurvey CAD is compatible with field data from all major total stations and data collectors and is fully compatible with AutoCAD. No plug-ins or modules are necessary. Complete survey drafting, COGO, DTM, Traversing, Volumes, Contouring, point cloud manipulation and data collection interfacing are included.

MicroSurvey STAR*NET is an easy-to-use Windows application that adjusts 2D/3D survey networks using rigorous Least Squares techniques. STAR*NET handles networks containing conventional observations with up to 10,000 adjustable stations. Differential levelling observations can also be included within a 3D adjustment. Whether a survey consists of a single-loop traverse or a complex network of interconnecting traverses, all observations are adjusted simultaneously to produce a single best-fit solution. STAR*NET can reduce observations to NAD27, NAD83 or UTM with separate grid factors calculated for all distances and t-T corrections calculated for all angles.

Contact:
t: 01200 429870 w: **www.surveyorsequipment.co.uk**

Storm GeoRiver

Storm GeoRiver is a standalone, cloud licensed river channel survey processing exchange. All processing of raw survey data can be completed with little manual handling and the software can also import and export data from ISIS, Mike11, Hec-Ras, XYZ and EACSD v3.2. All the standard DXF drawings and photo files can be exported too; aimed at both the surveyor and engineer.

Storm GeoRiver maps river information from the field into digital data files. Exact structure details, bed geometry and surface types can be exported into the new Environment Agency EACSDv3.2 format.

Storm GeoRiver improves the efficiency of processing while enhancing the integrity and completeness of the data compared to other survey processing software.

Storm GeoRiver is a flexible, economic software package with benefits to both the river surveyor and the hydraulic engineer.

Contact:
Storm Geomatics Ltd, Unit 28,, Ditchford Farm, Nr. Moreton-in-Marsh Gloucestershire GL56 9RD
t: 01608664910 w: **www.storm-geomatics.com**

Topcon MAGNET

Topcon's MAGNET solutions are cloud-based services which allow the smooth and immediate transfer of all of your important positioning data, from the field to office for on-the-fly processing, or sending out new setting-out schedules from the office to the field.

Experience true real-time streaming of all site information to and from any work-site with **MAGNET Enterprise**. With the ability to stream real-time site measurements for office personnel to work on, as well as various views on all company asset information. Always be in touch with what's going on! Log-in to a safe and secure account from any MAGNET software package for processing, visualisation and reporting.

MAGNET Office is a powerful and intuitive processing, design and drafting software suite that meets the demands of modern surveyors and designers. The core values are the ability to work with the largest variety of file formats, intuitive session visualisation and planning by activating the satellite background imagery and the integrated AutoCAD 360 cloud surfing. This allows other users to get involved, to visualise field measurements and perform CAD tasks on line-work from anywhere in the world.

Unique, intuitive and user-customisable field application software that enables users to collect survey mapping data and perform setting out, utilising total stations, GNSS equipment and digital levels.
MAGNET Field's quick codes data collection feature allows for personal on-screen buttons and single screen tap to log position attributes and site descriptions. Integrated controller cameras can be utilised to Capture Reality by storing unlimited photo notes with each measured point.

Contact:
Topcon GB Ltd. Minerva Court, Chester. CH1 4QL
t:: 01244 669999 e: **info@topconsokkia.co.uk**

Trimble TerraFlex

Now GIS managers can create and deploy fast, efficient forms for field data collection across a range of standard, mobile devices. Eliminate paper forms, no matter what kind of geospatial field work your teams are doing. With **Trimble TerraFlex™**, all of your field crews can deliver trusted and standardized geospatial data for fast integration into your GIS.

Android, iOS or Windows Mobile? Because BYOD initiatives are driving new demands for universal field systems, cloud-based Trimble TerraFlex has you covered.

With multiple field workers and countless field activities, you need to keep it all organized. TerraFlex gives you the flexibility to assign users to individual projects and manage the data coming in. Field data is automatically synced with a central server, streamlining office operations and driving higher productivity and cost savings.
Sign up today for a free 30-day trial of Trimble TerraFlex:

Contact:
w: www.trimble-terraflex.com

Technical Services

Looking for a company with special experience? Check our chart for details of leading firms & page 34 for more information.

✓ = service provided.

	Topographical surveys	Pipeline, railway, & other linear routes	Setting out for construction	Building & architectural (incl. measured surveys)	Heritage, historic, ancient monuments, etc.	Underground services tracing & surveys	GIS & mapping system data capture	Control surveys	Deformation monitoring	Proving surveys	Boundary disputes & expert witness	Hydrographic – near shore, river, estuarial, etc	GPS & other satellite positioning systems	Terrestrial laser scanning	Airborne laser scanning	Aerial photography	Ground radar	Infrared	Digital terrain analysis & modelling	3D visualisation & modelling	Remote sensing	Aerial photogrammetry	Terrestrial photogrammetry	Cartographic production	Industrial measurement/ metrology	Geophysical investigation
Anthony Brookes Surveys Ltd	✓	✓	✓	✓	✓	✓	–	✓	✓	✓	✓	✓	✓	✓	–	–	–	–	✓	✓	–	–	–	–	–	–
APR Services Ltd	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	✓	✓	–	–	✓	–	–	✓	–	–	–	–	–	–
Aworth Land Surveys Ltd	✓	✓	✓	✓	✓	–	✓	✓	✓	✓	✓	–	✓	–	–	–	–	–	✓	–	–	–	–	–	–	–
Fugro-BKS Ltd	✓	✓	✓	✓	✓	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Longdin & Browning (Surveys) Ltd	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	✓	✓	–	✓	✓
Maltby Land Surveys Ltd	✓	✓	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–	–	–	✓	✓	–	–	–	–	–	–
Mason Land Surveys Ltd	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	✓	–	✓	✓	–	✓	✓	✓	✓	–
NRG Surveys Ltd	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–	–	✓	–	✓	✓	–	–	–	✓	–	✓
The Scan Team Ltd	–	–	–	✓	✓	–	–	–	✓	–	–	–	–	✓	–	–	–	–	✓	✓	–	–	–	–	✓	–

Anthony Brookes Surveys Ltd
Unit 2, Thornbury Office Park,
Midland Way,
Thornbury,
Bristol BS35 2BS
Tel: 01454 419133
Fax: 01454 501711
e-mail: absurveys@aol.com
Contact: Anthony Brookes

APR Services Ltd
Block B,
Queens Road,
Barnet,
Herts, EN5 4DL
Tel: 0208 449 9143
Fax: 0208 449 9153
e-mail: tony.rogers@aprservices.net
Contact: Tony Rogers

Aworth Land Surveys Ltd
Norfolk House, Norfolk Way,
Uckfield, East Sussex TN22 1EP
Tel: 01825 768319 Fax: 01825 768310
e-mail: als@aworth.co.uk
Contact: John Witherden

Fugro-BKS Ltd
Midlands Office, 60 Stockerston Road,
Uppingham, Rutland, LE15 9UD
Tel: 01572 822963
E: tburton@fugro-bks.com
Contact: Trevor Burton

Longdin & Browning (Surveys) Ltd
Cherry Tree House, Carmarthen Road,
Swansea, SA1 1HE
Tel: 01792 644181 Fax: 01792 203333
e-mail: tom@longdin.co.uk
Contact: T. M. Cox

Maltby Land Surveys Ltd
2 Queens Road,
Haywards Heath,
West Sussex,
RH16 1EB
Tel: 01444 416246
Fax: 01444 417697
e-mail: rm@maltbysurveys.com
Contact: Richard Maltby

Mason Land Surveys Ltd
Mason House,
Dickson Street,
Dunfermline, Fife,
KY12 7SL
Tel: 0845 625 4500
Fax: 01383 739480
e-mail: info@mason.co.uk
Contact: Andrew Morris

NRG Surveys Ltd
Castle View,
Station Road,
Llanfairfechan,
Conwy, LL33 0AN
Tel: 01248 681240
Fax: 01248 680914
e-mail: nrg@nrgsurveys.co.uk
Contact: Nigel Green

The Scan Team Limited
Old Oak Cottage,
Potters Heath Road
Welwyn, Herts,
AL6 9SZ
Tel: 01438 816572
Fax: 01438 816572
e-mail: mark@thescanteam.co.uk
Contact: Mark Phillips

Classified Engineering surveying showcase 2013

CLASSIFIED SERVICES

We estimate that *Showcase* reaches over 6,500 surveyors, engineers and other professionals who work in geomatics, use geomatics technology or commission geomatic specialists. To advertise in *Showcase's* Classified section, call **+44 (0)1438 352617**.

AERIAL PHOTOGRAMMETRY

SURVEYS

FUGRO-BKS LIMITED
www.fugro-bks.com
Aerial Surveys
Topographical Surveys
Orthophotography
GIS Services
LiDAR
Midlands Office:
60 Stockerston Rd, Uppingham, Rutland LE15 9UD
t/f: 01572 822963

Aworth
SURVEY CONSULTANTS
SURVEY PROFESSIONALS
020 8263 6176 / 01825 768319
als@aworth.co.uk
www.aworth.co.uk
Land Surveys · Building Surveys · Digital Mapping
50 Years of Surveying

Anthony Brookes Surveys Ltd
Land, GPS, Building & Engineering Surveyors
Rail Surveys
Topographical Surveys
Measured Building Surveys
Unit 2, Thornbury Office Park, Midland Way, Thornbury, Bristol BS35 2BS
Tel: 01454 419133
Fax: 01454 501711
Rues Cottage, Westleigh, Tiverton, Devon EX16 7HS
Tel/Fax 01823 674446
E-mail:absurveys@aol.com
www.anthonybrookes.co.uk

Longdin & Browning
Measured Excellence
Innovative Survey Solutions Throughout The World
- Topographic Surveys
- Hydrographic Surveys
- Engineering Surveys
- GIS Services

www.longdin.co.uk
Cherry Tree House, Carmarthen Road Swansea SA1 1HE
Tel: 01792 644181
Fax: 01792 203333

CLOSE RANGE LASER SCANNING

apr services
land, building surveys, laser scanning
mail@aprservices.net
+44 (0)20 8449 9143
www.aprservices.net
www.pointools.com
Bentley Pointools V8i reseller
Bradlock anti theft device

MALTBY LAND SURVEYS LTD
- ★ Topographic Surveys
- ★ Measured Building Surveys
- ★ Elevations & Sections
- ★ Inshore Hydrographic Surveys
- ★ Rights of Light Surveys

2 Queens Road, Haywards Heath
West Sussex RH16 1EB
Contact: Richard Maltby
Tel: 01444 416 246
E-mail: rm@maltbysurveys.com

Mason Digital Mapping
www.mason.co.uk
- Land, Rail & Airport Surveys
- 3D Laser Scanning
- 360° Asset Imaging Survey
- Measured Building Surveys
- UGS & GPR Surveys

Mason House, Dunfermline, Fife, KY12 7SL
T:01383 727261 F: 01383 739480
Also at :- Horsham - West Sussex, Leeds - West Yorkshire & London Heathrow Airport

Are you listed yet?

PV Publications' online Survey Directory is a source directory for survey companies.

To check it out, go to:
pvpubs.com

INDUSTRY RESOURCE

THE SCAN TEAM
close range 3D laser scanning
- Laser Scanning
- 3D Modelling
- Independent Advice

Tel +44 (0)1438 816572
info@thescanteam.co.uk
www.thescanteam.co.uk

Location-Source
A UK-BASED PORTAL LEVERAGING THE POWER OF GEOGRAPHY
LOCATION-SOURCE offers analysis, opinion, webinars, longer articles, topical international news, reference material and more for users of varied knowledge levels.
REGISTER FOR FREE TODAY!
WWW.LOCATION-SOURCE.COM

SURVEY SOFTWARE

NRG www.nrgsurveys.co.uk
Land and Engineering Survey Software
Land Survey
Setting Out
Earthworks Volumes
Tel: 01248 681240
Practical Solutions to Technical Problems

Showcase Classified Services

Looking for a company with special experience?

See our Technical Services Chart on page 33 for a detailed analysis of advertisers' key competencies and services.

To advertise your company's expertise in the next issue, contact Sharon Robson on +44 (0)1438 352617 or sharon@pvpubs.demon.co.uk.

Advertisers' Index

To advertise in the next issue of *Engineering Surveying Showcase* contact Sharon Robson

Tel: +44 (0)1438 352617

Email: sharon@pvpubs.demon.co.uk

www.pvpubs.com

Introducing Geomatics World's Digital Extras!

We have recently introduced GW's Digital Extras section online with the March/April 2013 issue. With the increasing amount of high quality editorial that we receive, we plan to publish more material on the web for our readers. In addition to viewing the latest edition online, you can also download a PDF of the page for personal use and printing.

- If you're an RICS member you should be able to get your user name and password using your RICS membership number. Subscribers can email barbara@pvpubs.demon.co.uk to register for archive access.

Subscribers and RICS members have access to an online searchable database of more than a decade of articles from *Geomatics World.*

We are constantly looking for ways to improve the website and welcome serious feedback. Email your comments to editor@pvpubs.demon.co.uk

***FOR SUBSCRIPTIONS go to*: www.pvpubs.com**

TOPCON

Tuesday 29th October
Thorpe Park Hotel,
Leeds (LS15 8ZB)

Thursday 31st October
Inchyra Grange Hotel,
Nr Stirling (FK2 0YB)

Tuesday 5th November
The Kia Oval,
Surrey County Cricket Club,
London (SE11 5SS)

HYBRID BRIEFING SESSIONS

Hybrid Positioning – Improve efficiency and increase productivity on job sites, regardless of conditions, terrain or location with Topcon's Hybrid Positioning technology.

Come along to meet the Topcon team and our local dealers at one of our morning or afternoon sessions to see this great seamless integration of local GNSS and optical measurements!

Join us at one of three locations. Planned in concise morning or afternoon sessions to ensure you don't miss a full day at the office/ project, but don't forget to allow time for lunch also whichever session you choose….

Morning Session timings:

9.30 am	–	10.00 am	Arrival, registration, tea & coffee
10.00 am	–	12.00 noon	Hybrid Positioning briefing and demos
12.00 noon	–	1.30 pm	Lunch, Open demo sessions

Afternoon Session timings:

12.00 noon	–	1.30 pm	Lunch
1.30 pm	–	3.30 pm	Hybrid Positioning briefing and demos
3.30 pm	–	4.00 pm	Tea & coffee, Open demo sessions

To register:
http://onthemove.topcon-positioning.eu

Or call your local Topcon Area Manager:
Andy Flood – Scotland – 07770 427610
Andy Givens – North England – 07939 183926
Andy Clifton – South England – 07786 116943

Or contact your local Topcon Dealer.

topcon-positioning.eu

HYBRID POSITIONING