Engineering surveying *showcase* 2015

ISSUE TWO

FEATURES:

Laser scanning a Tudor warship

Mapping in the Scottish Mountains by UAV

Stuttgart date for InterGEO

The AiC Story: thriving after 30 years

Software for Geomatics

Aerial imagery & UAVs: fixed wing or rotary?

PLUS: we compare the latest UNMANNED AERIAL PLATFORMS & SERVICE PROVIDERS

and much more

Engineering surveying*showcase* 2015 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**

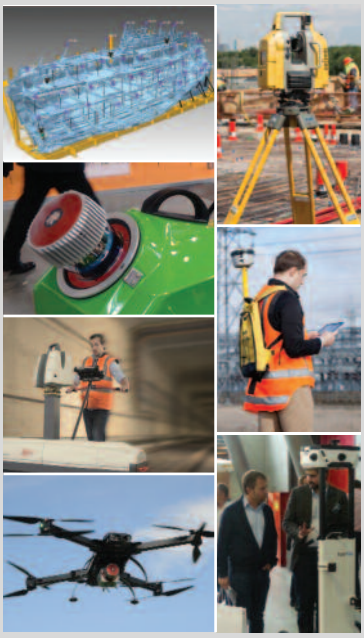
Publishers:
PV Publications Ltd,
2B North Road, Stevenage, Herts SG1 4AT, Tel: +44 (0)1438 352617,
Fax: +44 (0)1438 351989, e-mail: editor@pvpubs.demon.co.uk

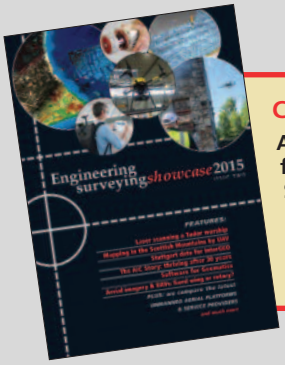
Editor: Stephen Booth ***Technical Editor:*** Richard Groom

Advertising sales: Sharon Robson ***Subscriptions:*** Sharon Robson

Printing: The Manson Group, St. Albans

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, Riegl and Topcon.*

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 published twice yearly (April and October) and distributed through print and digital editions to over 25,000 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:
http://www.pvpubs.com/Showcase/Free or call us on 01438 352617

Surveying, imaging & 3D scanning in **one** solution

Locate2Protect

SurePoint

VISION

Finelock

DR Plus

MultiTrack

MagDrive

Now you only need one instrument on the job site. Create 3D models, high accuracy visual site documentation, point clouds, and more using the Trimble S7, Trimble Access™ field software and Trimble Business Center office software.

With Trimble Locate2Protect, you can rest assured knowing your equipment is up-to-date and where it should be.

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

Measured Solutions
Construction | Surveying | Mapping

KOREC™

A software survivor reveals all, while we advise caution if you're booking a UAV survey

Welcome to the second issue of *Showcase* for 2015. This issue has a focus on unmanned aerial vehicles (UAVs) and software. On the latter I am delighted to present a potted history of a company that has not only been a constant supporter of *Showcase* since it was launched more than three decades ago, but is amongst a dwindling band of software suppliers in a market where there was once many.

Nevertheless, Applications in Cadd has not just survived but thrived. That path has not been easy however. Some hard decisions had to be taken in the early days that meant abandoning carefully constructed code and beginning all over again. That meant lean times for a while but the judgement proved right. Today, AiC remain one of the few strong players in the geomatics software market because they understand what surveyors and engineers want from their data, whether captured by GPS, total station, sonar or laser scanner. Their story is a reminder that all of these clever sensors and systems rely on equally clever software to process and interpret the data they capture and turn it into actionable information for someone. The digital age has given us lots of raw data, which can be turned into information, and which in turn can become knowledge. For AiC's full story turn to page14.

"Some hard decisions had to be taken in the early days that meant abandoning carefully constructed code and beginning all over again."

UAVs have rapidly become a significant market for both consumer and professional users. For surveyors and engineers they offer a way of mapping quickly a site, a route for a linear project or carrying out a close-range inspection of an otherwise hard-to-reach or inaccessible piece of infrastructure. **Richard Groom**, our technical editor unravels the pitfalls, explains why they have become so popular and considers the importance of the Civil Aviation Authorities regulations for the operation of these craft. For commercial applications operators must be trained and clients should ask for evidence of this, advises Groom.

UAVs divide into two distinct types: fixed wing and rotary. Further distinctions are between those which are sold primarily as platforms and those from suppliers offering dedicated systems. An example of the latter is that supplied by Topcon, the Sirius Pro, which survey firm Caintech has been putting to good use in the arduous conditions of the Scottish Highlands. You can read more about this on page 26.

This issue is not just about UAVs and software. It includes our regular Fresh from the market section plus a report on September's InterGEO event in Stuttgart. Both will provide you with a massive technology hit!

Lastly I am delighted to be able to provide readers with details of an unusual project that began almost 500 years ago when a famous English warship sank beneath the waves in sight of land. Today the Mary Rose has been raised and is in a dry dock at Portsmouth under constant monitoring from a laser scanner and total station. An extraordinary example of how our technology is being used to help preserve our heritage for future generations. You can read all about it on page 28.

Stephen Booth, editor

*The next issue of Showcase will be spring 2016. Copy date for editorial is **21 March.** Copy date for advertisers is **4 April** for publication on 18 April.*
*• Call +44 (0)1438 352617 for more details or go to **www.pvpubs.com***

ADVERTISERS

Fresh from the Market!

In each issue of *Showcase* we look back over the previous six months or so since the last edition and bring readers the significant developments in geospatial technologies.

LiDAR, Scanning & Imaging Systems

New LiDAR sensors from Riegl

Riegl launched several new products at their recent "two locations" user conference in Honk Kong and Guangzhou including the VP-1, an ultra-compact helipod turnkey LiDAR solution for a UAV with VUX-1LR sensor, camera, and IMU/ GNSS and control unit integrated.

The company also announced a series of high performance LiDAR sensors for kinematic laser scanning, each optimally adapted for mobile, UAV-based or airborne mapping as well as the VMQ-450, a mobile laser scanning system featuring a single scanning head. For more about Riegl's latest development turn to page 10 for our InterGEO report.

UAV mounted LiDAR

Routescene has collaborated with Hanseatic Aviation Solutions to develop a UAV based LiDAR system. The maiden flight of the integrated Hanseatic S360 and Routescence LidarPod took place in July in Bremen, Germany to collect 3D point cloud data of the runway at Bremerhaven Airport. The lidar pod is mounted in the nose cone of a fixed-wing aircraft, which minimises effects on GNSS/INS caused by noise and vibration from the rear engine. The S360 has a wingspan of 3.6m and can carry a payload of 6 kg and can operate in winds up to Force 7.

80 Mpx camera with high performance optics

Phase One Industrial has introduced the iXU-R camera series. Available in 80, 60 and 60 Mpx achromatic versions, they feature dedicated interchangeable 40 mm, 50 mm and 70 mm Phase One Rodenstock lenses equipped with central leaf shutters which can be quickly changed in the field. The cameras are small and lightweight with the high resolution of a medium format system, plus high performance optics and flexibility to fit into small places. For example, the iXU-R 180 is built around a large 80-Mpx sensor, with 10,328 pixels cross-track coverage yet is compact enough to be integrated into a small gimbal, pod or oblique/nadir array. It can also be used as a standalone photogrammetric camera with optional Forward Motion Compensation. The cameras offer direct communication with GPS/IMU systems and can write data to image files.

UAV flight restriction map

Aerial mapping company Bluesky has produced a prototype map for the UK showing where it may be unsafe or even illegal to fly UAVs. Bluesky has combined an expertise in flight planning and 3D aerial mapping with various geographic datasets to come up with the concept of a UAV Flight Restriction Map designed for commercial operators including 'No Fly Zones', areas where further advice should be sought as well as areas where no restrictions on flying are currently in place.

Pegasus:Backpack

Leica Geosystems has announced a mobile mapping system in a backpack. It consists of five high-dynamic range cameras, which work in a variety of light conditions, and a LiDAR profiler with an ultra-light and carbon-fibre chassis. The system creates a 3D view indoors or outdoors. GNSS, inertial measurement and Simultaneous Localisation and Mapping (SLAM) technologies are used to position the sensors.

Learn more about Leica's P40 scanner

In the last issue of *Showcase* we reported on the launch of a new range of laser scanners from Leica Geosystems. The P16, P20 and P40 offering improved range and much more. Log on to **https://soundcloud.com/hxgnradio/making-hds-work-for-you** to listen to an interesting interview by *GW* regular writer **Adam P Spring** as he interviews Greg Walsh, Leica Geosystems senior product manager for innovation. He talks to Adam about the Leica P40 laser scanner and the new technology within it. The interview provides insight to the engineering and significant features of the P40, including the integrated HDR camera, how it works and importantly the end products it delivers.

Drones, UAVs and flying things

Rotary-wing UAS for Europe

Topcon Positioning Group has announced the addition of a rotary-wing unmanned aerial system (UAS) to its mass data collection solutions line for the European marketplace. The Falcon 8 - powered by Ascending Technologies - is designed for inspection and monitoring, as well as survey and mapping applications. The Falcon 8 features an autopilot safety feature that provides three levels of redundancy for protection against performance drop or loss of control. Three IMUs synchronise all sensing data and identify, signal and compensate when needed.

TOTAL STATIONS

Long range reflectorless from Topcon

The latest addition to Topcon Positioning Group's line of reflectorless total stations is the GPT-3500LN. With a reflectorless measuring distance of 2000m (3000m with a prism), the instrument measures further than any non-prism instrument in its class. Time-of-flight pulse technology is used while a Topcon developed algorithm provides better signal noise to improve accuracy on dark and wet surfaces. The GPT-3500LN can connect to an external field controller, enabling field-to-office connectivity with Topcon's MAGNET suite of software. Additional features include a rugged IP66 rated design, on-board TopField application software, and battery life of up to eight working hours.

Self-learning total stations

Leica Geosystems has released what they claim is a revolutionary touch-technology software for world's first self-learning MultiStation and other total stations. Leica Captivate software enables users to capture and manage complex data easily and accurately. With little more than a simple swipe, users can navigate through customisable apps containing information for multiple projects. Advanced lining and coding come together to provide an interactive 3D model where users can zoom, pan and orbit the rendering for optimal viewing and manipulation.

New Trimble total stations

Trimble has introduced the S5, S7 and S9 total stations. The S9 is available as a 0.5" or 1" instrument and has Trimble's VISION and SureScan technology plus 4D Control software for monitoring. The S7 variant is billed as 'one instrument for all site needs' and has imaging and scanning capability. It also integrates with Trimble's V10 Imaging Rover and has a reflectorless range of 500m under poor conditions. The S5 is the workhorse of the range and does not have scanning or imaging capability. All instruments include Trimble's InSphere Equipment Manager with Locate2Protect (L2P) technology, providing real-time location tracking, geofence and impact alerts for tracking and reporting back knocks.

GNSS

New GNSS receiver from Sokkia

Sokkia has introduced the GCX2. Nicknamed 'the bullet', the new receiver exemplifies what Sokkia say is "a completely 'reimagined' approach to receiver design that offers an ultra-lightweight and ergonomic cost-effective solution." The multi-constellation and dual-frequency receiver is designed to offer affordable high-quality results for traditional applications in surveying and construction, as well as unconventional applications such as in landscape architecture, GIS, BIM and forensic mapping. The receiver connects via Bluetooth to the Sokkia GHX2 field controller enabling ease-of-operation within the MAGNET suite of software. The GCX2 utilizes 226 channels, each one optimized to constantly track any currently available satellite signals.

GNSS for drones

Septentrio has launched the AsteRx-m UAS, an RTK-accurate GNSS receiver board specially designed for the drone market, providing high accuracy positioning with low power consumption. The launch is complemented by the release of GeoTagZ software suite, which works together with the UAS camera to provide cm-accurate position tagging of the images without the need for a real-time data link.

GNSS receiver brings enhanced flexibility

Spectra Precision has introduced the SP60 GNSS receiver with a patented inside-the-rod mounted UHF antenna. Described as a versatile solution combining next generation GNSS technology, a high level of configuration flexibility and an innovative design, the SP60 is part of Spectra Precision's portfolio of GNSS receivers specifically designed for mainstream survey and construction applications.

The receiver features Z-Blade GNSS-centric technology running on a new-generation, 240-channel 6G chipset and is capable of fully utilizing all six available GNSS systems (GPS, GLONASS, BeiDou, Galileo, QZSS and SBAS), but can also be configured to use only selected constellations in an RTK solution. The receiver can deliver centimetre-level accuracy without terrestrial/cellular network availability.

Airborne LiDAR

Optech airborne bathymetry mapper

Optech announced the Optech CZMIL Nova, an upgrade of the CZMIL airborne bathymetric mapper. CZMIL Nova maintains its predecessor's sensing power, including a claimed unmatched turbid water penetration, whilst boosting installation flexibility with much lighter hardware and a more efficient laser with lower power consumption, facilitating operation in smaller aircraft.

Data Logging & Control

Windows move for Handheld

The Handheld Group announced an ultra-rugged handheld smartphone, the NAUTIZ X1 with Windows handheld 6.5 embedded. The Nautiz X1 is slim and lightweight yet incredibly tough with an IP67 ingress protection rating which means that it is fully dustproof and waterproof. It has been tested according to MIL-STD-810G military test standards to endure humidity, vibration, shock and extreme high and low temperatures.

Leica Zeno 20 – as simple as a smartphone

A new GIS data-collection solution, the Leica Zeno 20 can run on an Android or Windows embedded handheld device. Users can download favourite their Android apps to customise the data collector into a device as simple to use as their own smartphones. The Zeno 20 also offers two new flexible software solutions running on Android. Zeno Mobile is designed to provide an easy, flexible and efficient data collection workflow for the non-GIS and non-survey professional, whilst new Zeno Connect streams RTK-corrected GNSS positons to any app using the Android Location Manager.

SOFTWARE

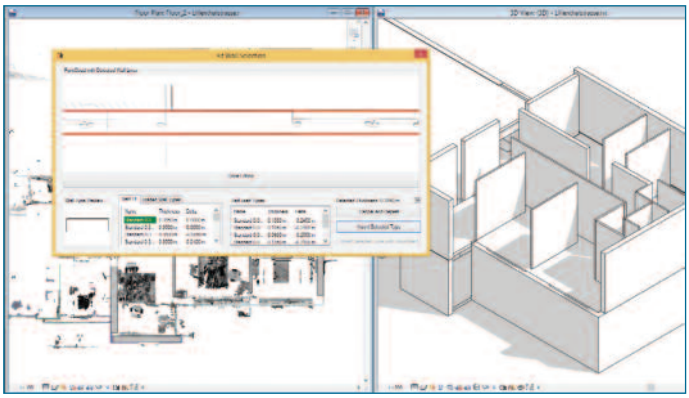
MBS floor plans 6.0

By reducing the need to use keyboard interaction MBS Survey Software believe more users will adopt tablet technology. They have achieved this for the latest version of their MBS Floor Plans by adopting a "ribbon" style interface and the introduction of new buttons. MBS Floor Plans V6.0 for Tablets uses the Windows OS. Highlights include: improved Bluetooth connectivity; a numerical keypad and other frequently used buttons to improve workflow; dock-able dialog boxes; file co-ordinate transformation via survey control stations; multiple vertex deletion and the ability to take geographically referenced photographs within the software.

Topcon integrates with Autodesk

Topcon has announced improved workflow compatibility for the GLS-2000 3D laser scanner and ScanMaster software with Autodesk solutions via the

PointSense for Revit



FARO Technologies has released a new software, PointSense for Autodesk's Revit building design software. The software significantly improves the evaluation and conversion of point cloud data for BIM. New features include: extraction and alignment of architectural walls, creation of Revit family types such as doors, windows, beams, construction lines and ground models, real 3D snap-to-point, plane detection and scaled ortho-image generation.

Colour-coded point clouds

Leica Geosystems has released a new version of its LiDAR Survey Studio software package for post-processing of airborne LiDAR data such as that from Leica's DragonEye, Chiroptera and HawkEye systems. The software includes a full-capability 3D point-cloud viewer and an analysis toolbox. Integration of point cloud data with RGB and near-infrared imagery from high-resolution cameras allow colour-coded point clouds in LiDAR Survey Studio software. The new version makes post-processing work more intuitive and reviewing of data easier as well as enabling advanced point classification, for example in forestry and vegetation classification.

latest versions of Autodesk ReCap and ReCap 360 which can now read the Topcon CL3 format as a scan file in addition to a standard point cloud. The scan file allows for the use of individual scan positions for additional options in registration workflows.

Global Mapper SDK new version

Blue Marble Geographics (bluemarblegeo.com) has released Global Mapper Software Development Kit (SDK) version 16.1. This release features multiple enhancements to speed-up online data sources, several new file formats and improved exports using image-optimised palettes. Blue Marble's geospatial data manipulation, visualisation and conversion solutions are used worldwide by thousands of GIS analysts at software, oil and gas, mining, civil engineering, surveying, and technology companies, as well as governmental and university organizations.

360° video imaging from Arithmetica

Arithmetica's SphereVision range of recording, processing and playback solutions allows the creation of fully interactive 360° videography. With the ability to integrate floor plans, architectural drawings and other types of documents, SphereVision is aimed at police and security applications including risk assessment, event management, training, incident response and post event analysis and investigation.

MAGNET v3.0

Topcon has updated its entire MAGNET suite of software. MAGNET v3.0 includes new and enhanced features designed to increase interconnectivity and productivity. "Data exchange is more fluid than ever before between the office and the field with the addition of Topcon eXchange for CAD," says **David Ahl**, director of software product management. "Now users can take advantage of seamless data transfer of Autodesk solutions to Topcon solutions without additional file conversion steps."

The update includes new project management functionalities such as redlines, schedules and tasks, and timecards — as well as new software installation and update methods designed to offer convenience and a simplified overall experience for the user.

BRIEFS

Trimble has introduced the Spectra Precision FOCUS DL-15 Digital Level with electronic height measurement capability for a wide range of survey and construction tasks.

Ground-breaking new technology for accessing and adding intelligence to laser-scan projects is claimed from the latest version of the scanning software LFM. Version 4 delivers significant capabilities for project collaboration and asset management. Products include LFM NetView and LFM Server with the introduction of 3D mark-up functionality allowing users to add, access and share asset intelligence in the form of tag identifiers, attributes and comments

Septentrio has launched the AsteRx 4 OEM is a multi-frequency, multi-constellation, dual-antenna receiver, incorporating Septentrio's latest GNSS tracking and positioning algorithms.

The latest version of Leica GeoMoS (v6.2) comes with an updated GeoMoS Monitor, allowing management of data collection and computation for multiple monitoring projects at the same time. In addition, Leica GeoMoS Now! 6.2 is available in the cloud.

Teledyne Optech has announced the CMS V500, a complete redesign of its Cavity Monitoring System that introduces a live video feed, cable-free operation, and other critical new features that improve safety and efficiency in underground mining.

Trimble's TerraFlex software now incorporates tools that streamline data collection and data update process, minimising repetitive steps and maximising data quality.

A new Trimble Power Line application provides an Access module for power transmission line surveys, recording points on both power line attachment structures and transmission lines through a streamlined conventional survey workflow.

The 7" Leica iCON Controller CC80 is a small lightweight unit with outstanding outdoor visibility, enhanced iCONstruct field software with real-time project information and the Leica iCON gps 60/80 which uses SmartLink to bridge accurate positioning wherever RTK is interrupted.

Opti-cal Survey Equipment and GeoSLAM have formed a partnership to market the ZEB1 laser scanner, the first truly mobile handheld scanner which captures data in previously difficult surveying locations. Without the need of tripods or targets, the user can simply walk through the environment to be surveyed and rapidly record more than 40,000 points per second. Raw scan data is then uploaded into the GeoSLAM Cloud where SLAM software converts it into a fully registered point cloud. More at: http://surveyequipment.com

Swiss drone manufacturer senseFly has announced that its eBee fixed-wing UAV has become the first to be designated as a 'compliant small UAV' by Transport Canada, a distinction that moves organisations that use this drone a critical step closer to achieving Compliant Operator status.

Arithmetica is making 3D model project collaboration easier by taking advantage of Sketchfab, an online platform for sharing 3D files. By automatically converting very large point clouds into manageable 3D models, at a fraction of the size, and uploading Pointfuse Pro generated textured 3D models to Sketchfab, content can be shared and users can visualise their projects in true 3D.

An upgrade for Topcon's ScanMaster software sees version 3.05 enhance performance enabling larger point clouds from the company's scanners as well as memory overflow improvements when the operator creates large point clouds and views wide images.

Stuttgart hothouse showcases evolutionary technologies

Geomatics World editor Stephen Booth reports from the world's biggest exhibition of geospatial technologies.

EARLY AUTUMN TRADITIONALLY means a trip to Germany for the editor of *GW* and 2015 was no exception. The Intergeo event, now in its third decade, fell in Stuttgart this year (2016 is Hamburg then Berlin for 2017). As RICS Land Director **James Kavanagh** observes, "The event is always a hothouse of new ideas, geo technology and a great indicator of how. . . . global geomatics is evolving."

The last time Intergeo was in Stuttgart (2004) there were only 250 exhibitors. This year the three-day show attracted a record 549 exhibitors occupying some 15,000 square metres and some 16,500 visitors of which over 30% were first timers and half came from beyond Germany. The new Stuttgart Messe could not have been better located: right next to the airport. Yet in one respect a pity as I suspect too many visitors just flew in for the day, missing an attractive city with a lively nightlife and other attractions including the home of car-maker Mercedes Benz (the editor confesses to bunking off for half a day to visit this fascinating and impressive facility that encompasses not just vehicle history but much more. Did you know, for instance, that MB supplied pre-1914 London buses?).

At the Intergeo organisers press conference there was much talk of "Geospatial 4.0" which seems to be about intelligent networking. I must confess to having overlooked Geospatial 1, 2 and 3, although Esri in a press release defined 4.0 as "to integrate and link any information to space." However one attempts to define and categorise our business it is probably best to focus on the technology and what it can do for users.

The following is little more than a snapshot of what was on offer at Intergeo. We will have missed plenty but we think we've captured some of the more significant developments from companies who are players in the UK.

Droning again. . .

If it is possible to discern particular technology themes this year then one has to be drones and shrinking mobile mapping systems. It was very much the flying things that created a buzz, literally. Drones, UAVs, call them what you will enjoyed their own hot spot, the 'flight zone' where manufacturers were able to demo their craft in the air. It really is remarkable that these devices, both fixed-wing and multi-copter, have developed so rapidly as data gathering platforms during the last four or five years, encouraging an equally impressive evolution of lightweight sensors as we shall see.

Several manufacturers have focused on developing UAVs for a dedicated application. Riegl's **RiCoptor**, one of the first with a LiDAR sensor, now has a bathymetric companion, the **BathyCopter** which incorporated a green laser rangefinder developed by Riegl. The latest **Aibotix** multicopter UAV can now carry a multi-spectral sensor as well as enjoying RTK corrections via sister company Leica Geosystems' SmartNET service. Trimble meanwhile, has launched its first multi-rotor UAV, the **ZX5** with a 16 Mpx camera. Topcon too were showing their first step into this type of platform with the **Falcon 8** Octocopter with a 36 Mpx camera and the ability to be "back-packed". You can read more about the current market for UAVs in our special feature, pages 18 - 25.

***Right**: James Kavanagh (centre): Intergeo is "always a hothouse of new ideas. . ."*

***Left**: Riegl's BathyCopter is a UAV and sensor that can penetrate the water column for inshore surveys.*

Mobile mapping

Mobile mapping has been quietly moving ahead, also helped by miniaturisation of sensors and much more compact solutions. 3D Lasermapping, which has been in this field for many years, launched the compact **StreetMapper IV** system with just one connecting cable between the vehicle platform and sensor unit. The sensor package includes a high-resolution panoramic camera, laser scanner, MEMS inertial unit, GNSS and control unit, all of which fit neatly in a protective pod.

Leica Geosystems were showing the latest incarnation of their **Pegasus** mobile mapping system, a backpack version. Applications include BIM as well as 2D mapping; accurate positioning is achieved in GNSS-restricted areas using Simultaneous Localisation and Mapping, or SLAM, technology. Together with a high precision inertial measurement unit, Leica describe this as a "position-agnostic solution". Sensors log position and time with full 360° views and LiDAR plus a hardware light sensor, mean that images are usable while other functions are verifiable and adjustable through the operator's tablet device.

The Trimble **MX7** system heralds a new generation of affordable mobile mapping systems and mounts easily on a variety of vehicles of all sizes. It includes an embedded computer operated by a touch-screen tablet using Wi-Fi technology. The MX7 captures 360° fully-direct georeferenced imagery



***Above, from left to right**: Leica's Pegasus Backpack for mapping on the move uses SLAM technology. The latest version of 3D Lasermapping's Streetmapper is now an easily transportable pod. Skinny Cappuccino please! Nein, Nein! This is interior mapping Sir. . . it may well be the next big thing.*

using a spherical camera and GNSS/INS technology. Imagery is calibrated for high-accuracy photogrammetry, allowing users to position, measure, annotate and extract information. Applications include construction, survey, asset management, rail, civil transport, mining, oil and gas, site documentation, workforce training, city planning and 3D visualization.

GNSS

Designed for GIS and survey professionals, Trimble's latest GNSS receiver works with their handheld devices and iOS, Android or Windows mobile handhelds, smart phones and tablets using Bluetooth or via USB. When paired with a mobile device, the **Trimble R2** receiver adds professional-grade GNSS capabilities to enable high-accuracy data collection.

Totally total stations

Counting the many Chinese manufacturers, there must now be more than 20 different total station brands. Big players like Leica and Trimble even have two (GeoMax and Spectra Precision respectively).

Topcon Positioning Group introduced the **DS-200i** direct-aiming motorised imaging station compatible with the new Autodesk BIM 360 Layout app for the Apple iPad. The DS-200i is the second total station solution that Autodesk and Topcon have collaborated on for contractors. The DS-200i offers a reflectorless solution with a range of up to 1000 metres without the need of a prism, and 5,000 metres with one. The built-in wireless WLAN connects the iPad with the BIM 360 Layout app. But no Android yet?

A new range of motorized total stations was announced for Trimble's Spectra Precision brand. The **Focus 35 RX** robotic instruments move the power of the observer from the instrument to the detail pole, improving efficiency. Speed of observation and precise positioning is provided by patented StepDrive motion technology, which controls the horizontal and vertical motion of the motors, eliminating the need for traditional motion locks. The Focus 35 RX includes a tracking sensor that uses LockNGo FastTrack tracking technology, enabling the instrument to constantly lock onto the prism and is available in 2", 3" or 5" accuracies.

Laser scanners

Driven by Building Information Modelling (BIM), 3D laser scanning and imaging software are behind many survey applications as well as construction planning and design. Trimble's latest laser scanner, the **TX8 3D** offers greater accuracy (down to 1 mm) and streamlined onboard operation in measuring to longer ranges, decreasing field time for capturing high-accuracy data. The latest Trimble **RealWorks** 10.0 software includes an improved user interface with a simplified menu structure and guided workflow. A new automated, one-button targetless registration routine simplifies the process in combining multiple scans while new classification tools introduce greater flexibility and automation for processing and delivering point clouds.

Topcon refreshed its laser scanner range with the announcement of three new models. Using Topcon Precise Scan Technology II, the **GLS-2000** models are designed to emit pulse signals three times faster than earlier GLS scanners. "Using faster pulse signals enables timing to be detected more precisely, which results in reduced noise and higher-accuracy data," explains Charles Rihner, vice president for the Topcon GeoPositioning Solutions Group. Additionally, the scanners feature dual 5Mpx cameras, including one with a 170-degree wide-angle lens for high-speed imaging, as well as an 8.9-degree telephoto camera coaxial with the measuring axis.



***Above, from left to right**: Trimble's latest GNSS R2 receiver is designed for survey and GIS apps and works with smart phones and tablets. The TX8 3D is a new laser scanner from Trimble offering close range accuracy down to 1mm. Topcon's new GLS-2000 scanners are three times faster than earlier models and include a 5 Mpx camera.*

***Above**: Riegl's latest terrestrial scanner, the VZ-400i has an 800m reange and scan rates of over 1 million points per second.*

Austrian company Riegl has five decades experience of developing lasers. Their latest terrestrial scanner, the **VZ-400i** offers scan rates up to 1.2 mHz with 5mm accuracy. Range is 800 metres and operation is via a touch-screen. An integrated gyroscope, accelerometer, compass and barometer help re-assure users that conditions are right for data collection.

But perhaps, whilst the VZ-400i is an evolutionary product, the most interesting development from Riegl is the **VUX-1UAV**, an ultra lightweight laser scanner designed for use with a UAV (see also our feature on UAVs where Riegl's RiCoptor is featured). The VUX-1UAV is described as a survey grade scanner operating at 200 swathe scans a second capturing data at 500k points a second. Impressive from a unit that weighs just 3.5 kgs and is sized at only 227 × 180 × 125mm. Accuracy is quoted at 10mm and precision 5mm. Data is stored in a 240Gb memory and power consumption is typically 60 Watts from an 11-32V DC supply. More powerful versions offering higher scan rates and designed for use with light aircraft and helicopters or terrestrial mobile platforms are also available using the same lightweight sensor.

FARO Technologies updated its laser-scanning software **PointSense**. This is a surveying and as-built documentation software suite for the construction industry. With the release of Version 16.5, PointSense now includes additional tools and functionality for efficiently processing 3D laser-scan data in Autodesk's AutoCAD and Revit packages. The functionality for AutoCAD includes simultaneous fit of multiple polygon cross-sections, single click plane extraction, and auto-boundary detection. New plant design tools include batch extraction of multiple structural steel elements and enhanced flange tie-in point extraction. Revit users benefit from new, intuitive deformation tools for comparing point clouds to any surface including walls, floors and ground. Additionally, users of Agisoft's **PhotoScan** software can now import their calibrated photos into PointSense's Heritage tools as an additional reference source for processing their point cloud data.

We've already mentioned SLAM technology, which is helping mobile systems stay on track when GNSS is weak or unavailable. Readers may also be familiar with the ZEB1 handheld laser scanner, which has featured in recent past issues of Showcase. But the SLAM technology behind that device was developed through a joint venture between CSIRO (Australia's National Science Agency) and 3D Laser Mapping from Nottingham and now marketed through Geoslam Ltd. Now the technology has also been built into a tiny laser scanner weighing only 1.2 kg: the **GeoSLAM ZEB-REVO**, which can be mounted on a variety of platforms to capture up to 40k points per second. Once the data is captured users have to upload it to Geoslam's cloud for processing into a 3D model. The potential applications and integration into mobile and aerial systems are exciting. Watch this space.

The GEO Business team hard at work. . . we think.

Airborne mapping

CMOS (Complementary Metal Oxide Semiconductor) sensors have been around for awhile in consumer cameras. Now Leica Geosystems has introduced the **DMC III** with the industry's first large format CMOS airborne sensor. Based on new CMOS, imaging sensor technology, the DMC III offers the world's most efficient coverage performance in a single frame sensor at 25,000 pixels – 25 per cent more than any other camera on the market. The camera uses a single monolithic sensor providing 391 Mpx. The new technology also includes benefits like 78dB dynamic range and extremely low image noise level, allowing customers to fly more hours per day. The design of the DMC III supports Leica's common sensor platform with LiDAR and oblique sensors to minimise operating and training costs.

Elsewhere. . .

The development of high-resolution sensors like 3D laser scanners has enabled the creation of dedicated systems like **SiTrack:One**, a highly-accurate rail track maintenance and refurbishment system incorporating the Leica ScanStation P40 to generate 3D point clouds. This is a total solution for rail maintenance and refurbishment that produces survey-grade 3D point clouds for accurate as-built drawings.

• Intergeo moves to Hamburg next year. Dates to note are 11-13 October. Don't miss it!

***Left**: Leica's latest railtrack measuring system incorporates the latest ScanStation P40 laser scanner.*

***Right**: A masterpiece of engineering – the tiny Riegl VUX1-UAV laser scanner, which weighs just 3.5 kgs.*

AiC: still flying after 30 years

Why do some software companies fail whilst others thrive? To find out, the editor visited a small company to meet the MD in the Leicestershire town of Shepshed.

I OFTEN WONDER with software, and especially that designed for phones and the mobile age, if the programmers really have any idea what we use them for. My Android phone for instance, when I draft a text message and send it off to someone, anticipates that my next move will be. . . to send them another one! Now why would I want to do that?

Fortunately for surveyors and engineers the bulk of the software they use is not like that. The developers are in a fiercely competitive market, especially those who are not tied to an instrument manufacturer. The canny ones are not just software developers – they know exactly what their end users need and have had the experience of going out and doing real surveying. Applications in CADD Ltd (AiC) is very much in that category. They understand the many applications that surveyors, engineers and others who rely on survey instrumentation are likely to need.

Our story begins back in the 1970s when many people were getting excited about the potential that computing offered, the so called second industrial revolution. CAD and design were obvious applications but so was surveyors' basic stock in trade: topographic survey and creating a ground model from a series of points with heights.

Founded back in the mid 1980s as ACAD and changing to AiC in 1990 (to avoid any possible confusion with AutoCAD), the business has in some respects survived against all the odds. Back then, there were many competing software packages for terrain modelling. A quick look in the first edition of *Engineering Surveying Showcase* in 1992 reveals no less than 15 packages, the majority of which by the early noughties had either fallen by the wayside or been absorbed into others' software product lines.

First stirrings of the computer bug

So how has AiC not just survived but thrived? Since its foundation the company has been led by Dr **John Strodachs**. Following a PhD in ground modelling in the 1970s – then an emerging technology made possible by steadily increasing computing power – he took up an early career in academia, which gave him the opportunity to write some survey modules for the HP41c handheld logger, a device popular with surveyors back then as it offered some real computing power along with plug-in apps.

"Then the Apple II arrived in Hong Kong!" recalls John. "I was like a kid with a new toy, writing software free from the constraints of a main frame, but when I came back to the UK I put it to one side".

In 1982 he joined LUT to work on CAD projects for structural detailing with the LUCID group – a consortium of construction and design companies using standard detail on transparencies that could be printed, along with other design details, on drawings. The CAD systems used at LUT included PAFEC DOGS and MEDUSA, a 3D modelling package. John ran a number of student and research projects using these CAD platforms, describing CAD as "a solution looking for an application". Whilst at LUT he was approached by a family friend who asked him to write software for survey processing with graphics for the Apple II. This was his first taste of writing commercial software.

John left LUT in 1985 to set up his own software company with Mike Case, a post doctorate student he met whilst teaching at LUT. Mike was working on a sewage treatment works analysis project for Severn Trent Water Authority, called CHAT, which was coming to an end.

John was determined that any ground modelling package they developed would have to include a good CAD package. After all, a survey is a collection of coordinated points, the same as CAD; why not package the two hand in hand? At that time AutoCAD was only just becoming available and had many competitors. It was also expensive. John was looking for a good affordable CAD to integrate with. A chance meeting sent him off to South Africa to investigate something called ProCAD, then being ported down from a Sun Spark workstation onto the IBM PC, which was soon to become the industry preferred platform.

Getting into bed with ProCAD was AiC's first big break. It had all the third-party tools necessary for developers like AiC. It was also half the price of AutoCAD. The result was ProSURVEYOR. But we're getting ahead of ourselves.

To develop the new DGM/CAD software would take time so a less ambitious package was developed as a stop gap: MicroSURVEYOR. Once ProCAD was available they began integrating. It took nine months but by early 1986 they had a saleable system with a road alignment module. Redlands Aggregate were their first paying ProSURVEYOR customer.

John ruefully concedes, "We were successful because of the support we got from the South Africans. They were well ahead of AutoCAD at that time and doing very well in the US", adding "reviews of ProCAD nearly always put it on top". In their New York office they were selling tens of licences a day! But then they hit the apartheid problem and the restrictions that the Americans had put on dealing with the South African regime.

Computers, computers. . . but which one?

In the early 1980s before the widespread adoption of the PC, the only way to get serious processing power for applications like ground modelling and CAD was to use a mini computer. For many that meant the Wang,

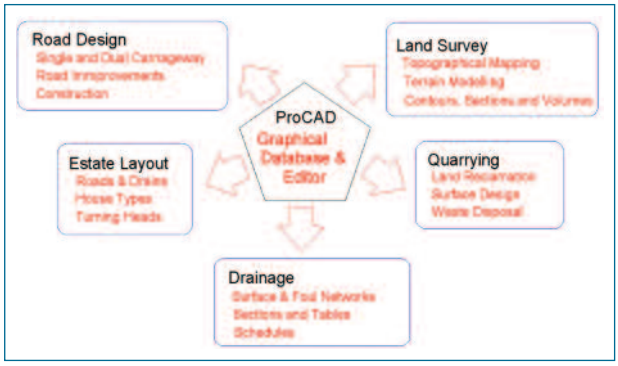


Figure 1 *- ProCAD at the Centre of ProSURVEYOR*

John Strodach's Profile

- First degree in Civil Engineering (1971) from the University of Nottingham
- Three years working in industry with a contractor and a design consultancy
- PhD in ground modelling (1978), also from the University of Nottingham
- Post PhD teaching and research at Hong Kong Polytechnic, Portsmouth Polytechnic and Loughborough University of Technology (LUT).

then used by market leader Ground Modelling Systems and their Eclipse system. But because their program was written in P-code it was very difficult to easily migrate to the PC, which by the late 1980s was widely available (and cheap).

Five years ahead

ProSURVEYOR did well right from the start and sales rose rapidly. It was just what surveyors had been waiting for. "We were five years ahead of the market back then," says John. "But we had no experience in sales and marketing", he added. "Sales came in easily at that time. All we had to do was complete a demonstration of ProSURVEYOR and it sold itself. We used an Olivetti PC with less than a megabyte of RAM but with a maths coprocessor chip and 40 Mb hard disk".

Major competitors at the time were MOSS and Eclipse. But AiC had more than one advantage: they worked very closely with the survey instrument manufacturers and particularly at that time AGA Geotronics (later to become Spectra Precision, subsequently acquired by Trimble) and Optimal Software, then specialising in data capture on the Husky Hunter and later the Psion Organiser handhelds. "We did very well with the ProSURVEYOR system with the backing of Geotronics", recalls John. So much so that one of Geotronics sales guys, Dr Chris Deeth, joined AiC as a director, for a while. A cut-down version of ProSURVEYOR was developed, without its CAD platform, called IntSURVEYOR.

The migration to DOS

The South Africans started working on a Microsoft Windows product called Expert Series moving away from Pascal to the "new" programming language C++. It was a massive technology transfer but the results didn't look good. "We hit a wall with the Expert Series as its graphics were too slow, redraws taking up to 30 seconds". There was also the problem of restrictions placed on companies who dealt with the apartheid regime.

The only option was to change the platform and going 'cold turkey' – starting from scratch. Writing everything in house, but sticking to the Microsoft DOS platform. "We were introduced to C++ and saw that this was the way forward for programming", explained John. As part of this development, AiC insisted that the new system must have CAD, so they began writing their own CAD package! This meant tough times ahead with few sales until the new system was available. "Two developers were working virtually full time on it", John recalls. "Meanwhile we had to keep IntSURVEYOR and ProSURVEYOR going". AiC's business model works on a one-off sale and provides optional maintenance contracts, which means they have to work hard to retain clients.

Force but not with everyone

It was worth it in the end. The new package dubbed "4ce" was launched in 1994 to much acclaim. It was originally planned to call it Force with a subtitle from Star Wars ("May the force. . . etc). Alas, at the last moment it was discovered that the name had been trademarked as a toilet cleaner! One bright spark suggested 4ce stood for "4 Civil Engineers".

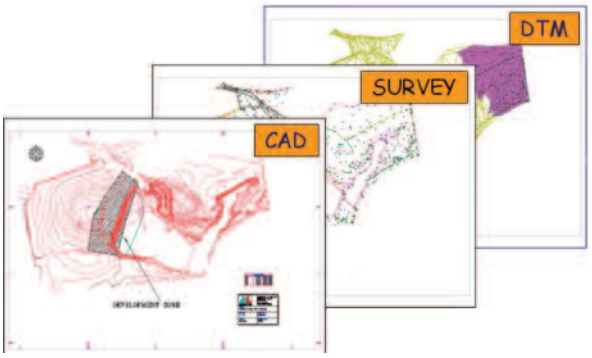


Figure 2 *– 4ce with its separate Overlays*

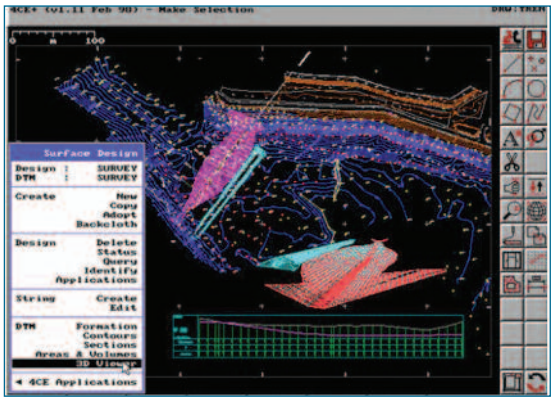


Figure 3 *– 4ce User Interface Mixing CAD with Modelling*

"The launch of 4ce was a big game changer" recalls John. One of the problems we had with ProSURVEYOR was the additional support files required to retain survey coding and DTM intelligence. Lose or corrupt one of these support files and things could go amiss. CAD systems have no real intelligence and are simply electronic drawing boards!

"With DOS 4ce we introduced overlays, which meant that we could mix both CAD and models in the same graphics environment, but stored separately, with the ability to snap to detail in either format. The graphics seen in the models is created from feature codes using a code table to generate attribute data including points, lines, text, and symbols"

It's worth digressing for a moment and comparing what ground modelling software was like then compared to what is available today. Back in the 1980s 100 points was often the maximum you could

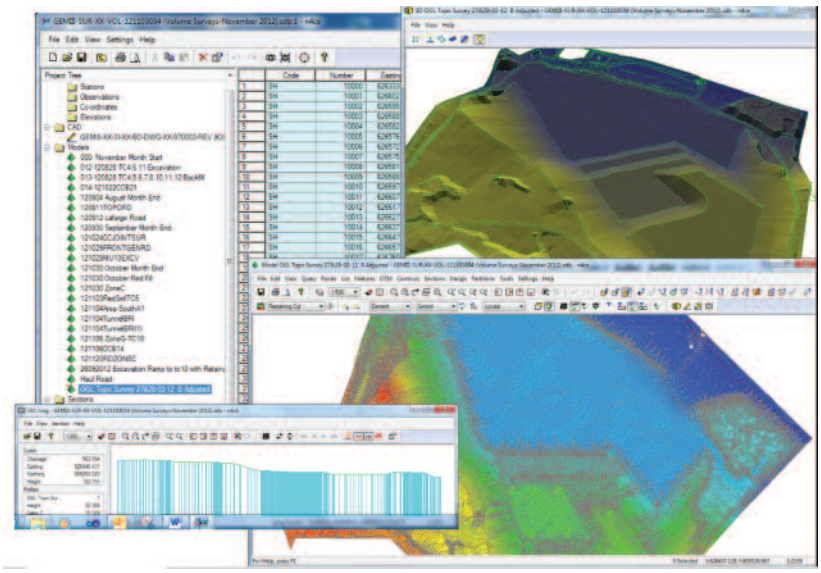


Figure 4 *– n4ce Multiple Windows User Interface*

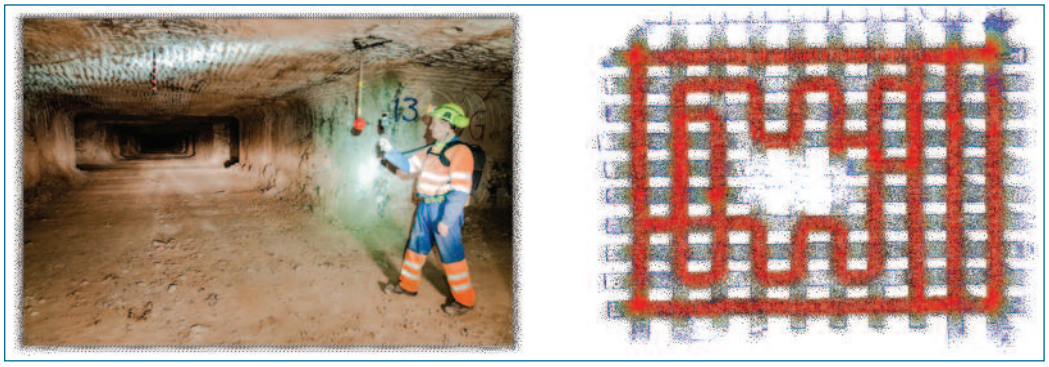


Figure 5 *– 4Site Clouds Data Capture (Courtesy of British Gypsum)*

get in a simple system. To process a triangulation of 800 points could take hours – "we left it to churn away overnight!" recalls John. "Now we have to contend with gigabytes of point clouds! We can now triangulate tens of thousands of points in seconds".

The move to Windows

It took quite a while to come up with a Windows replacement for DOS 4ce. A completely new product, n4ce (new 4ce), was released in the millennium year, and immediately found favour with surveyors. Today n4ce runs on all post Win '95 platforms. Meanwhile many users have found that their DOS packages don't always work on Windows platforms. ProSURVEYOR worked up to Windows 95 and DOS 4ce worked up to Windows Vista. Both have been pensioned off.

Recognising the limitations of its predecessors, n4ce was written completely from scratch with three main requirements. Firstly, everything had to be stored in one environment, called an SDB file, including survey data, point coordinates, CAD, Sections, Models, Drawings and Alignments. Secondly there should be both spreadsheet editing of data as well as graphics – called duality of display and edit (DDE). And finally the ability to open multiple windows allowing changes in one to ripple through into others. Data is seen and accessed from a project tree and CAD no longer takes pride of place but becomes just another tool. The ability to overlay different data types is carried over from DOS 4ce, making n4ce the ultimate geomatics software toolbox!

Having now made the big move to Windows one might think it would be plain sailing. Wrong! John explains: "Apart from a big learning curve and introducing new features into n4ce, one of the challenges we faced was upgrading to different versions of Windows. Software tools that worked fine in earlier versions were no longer supported as we migrated to a new development platforms. A Typical example was the toolkit that we had in Win3.1, which no longer worked in Win2000. In December 2014, a 64-bit version was created and multi-core processing introduced. This increased the capacity and processing power of n4ce, extending its life. As with all successful software packages, change is constant and the latest developments of n4ce allow processing of point clouds and LiDAR data."

What has been the hardest challenge to date? "Every step we take is a challenge" says John. "The biggest was by far to let go of ProCAD and go 'cold turkey' to produce an MS DOS product, 4ce. This was a make or break for the AiC".

AiC and their competitors LSS, are almost the last standing independent terrain modelling software developers in what was once a big field. As John observes, "The value of any software is only the people behind it." Right from the start he chose wisely in his staff appointments. At one stage there were four high flying PhD's. **Mike Case** joined in the early days whilst they were developing ProSURVEYOR. His colleague and fellow director **Phil Langrishe**, joined in 1998.

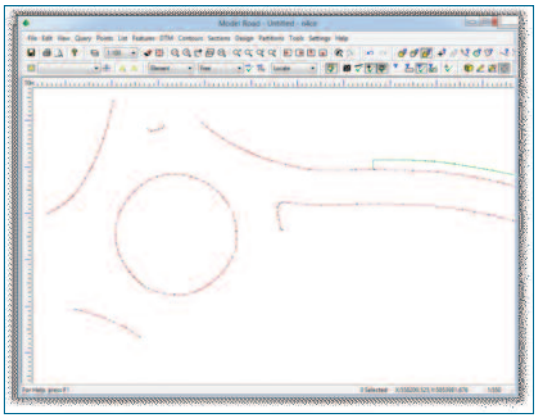
Other members of the team include **Karen**, who has been with AiC for 12 years and looks after the front office, with **Deborah**. **Andrew** joined AiC two years ago as an apprentice support technician, graduating this year as a valuable member of the team. Meanwhile **Evgeny** joined for the summer on a Santander bank sponsored internship working on improving internal database management. Russian born but now a British citizen, Evgeny speaks fluent Japanese as well as his mother tongue and is studying earth sciences at Cambridge University.

When I visited AiC last July I was impressed that John and his colleagues are not just software developers. They understand surveying to the point where they can and go out in the field and survey. Recent developments have seen the application of hydrographic software to collect GNSS data via a small remotely controlled boat, which has led AiC to take on surveying contracts to prove the system. They were off the next day to the Port of Felixstowe to measure river bed profiles in the estuary.

For site. . .

Phil Langrishe has led the development of a new package designed to be taken into the field on a ruggedised tablet. Branded 4Site, this data-logging software will run on any Windows tablet. "It's all

Figure 6 *– n4ce Socket working with Point Clouds (courtesy of The Severn Partnership)*



Above*: Trimble RealWorks as a Viewer.*

about data capture", explains Phil "The purpose behind developing 4Site standalone (as well as the AutoCAD version) is to get better integration with the data capture process, so data from the field into our software is seamless". Working on a tablet in the field can be problematic. "You need both a touch-screen and a stylus for when it rains." The idea is to take the thinking out of the data capture process by always checking what you've done to see if it makes sense and is logical. "It guides you by the hand," adds John.

Today, AiC works closely with all the leading survey equipment suppliers, each of which has their own data acquisition software, either on the instrument or a separate handheld controller.

So, why buy 4Site rather than the instrument manufacturer's own onboard software? "Because we will give you a full blown drawing in a DWG file format," says Phil. One of the strengths of this software, argues John, is that you can use it with a low end entry-level instrument and get advanced functionality. We link to most popular instruments with the same user interface putting the user in control of the instrument". This is a point which may be worrying the instrument manufacturer's, intent on selling ever more complex devices that combine GNSS and laser scanning.

For everyone

The challenge for companies like AiC, is to develop and maintain software that can work seamlessly with new devices and handle the various file formats used by the industry, such as DWG/DXF for AutoCAD, Bentley GENIO and Land XML. The latter increasingly recognised as a de facto standard for survey and land information data. AiC works with this data to create DTM and CAD models. "We have to make sure that our software works seamlessly with every instrument".

In addition to dealing with basic surveys and hydrographic models, AiC's 4Site data capture software has a Rail module, which is part of the Abtus TMD system; a module for Leica's 3D DISTO and another for point clouds using the ZEB1 handheld laser scanner.

A recent development with n4ce allows it to create vectors from point clouds by using a "socket". Simple in concept, this works by n4ce listening to queries made in point cloud software and allocates a feature code. "You run the two products simultaneously" explains John, "and vectors will then appear in n4ce automatically." Just another example of lateral thinking by the team at AiC. The example opposite is using Trimble RealWorks as a Viewer.

So what does the future hold?

Crystal ball gazing, John comments that in the early days working with ProSURVEYOR they were so far ahead of the competition that they could predict the next stages of development, but couldn't account for recessions. We've just gone through one of the worst in living memory but technology continues to move on with frightening speed.

Being a small high, technology company AiC can change direction very quickly responding to customer needs, such as integrating new tools into its software portfolio for specialist applications like its 4Site developments. New integrated products are being prepared with new licencing arrangements making it easier for clients to access solutions using the Internet, wherever they are.

Aerial imagery from Unmanned Aircraft – fixed wing or rotary?

Aerial photography taken from unmanned aircraft is the technology of the moment, with many equipment manufacturers, software developers and service suppliers getting in on the act. **Richard Groom** reviews the state of the technology, provides some advice for clients and sets out the regulator's rules.

UP UNTIL 2000, TO MAP AN area of more than about 50Ha the technology of choice was photogrammetry. Overlapping vertical aerial photography was taken using specially adapted light aircraft with heavy, expensive, calibrated metric cameras. This enabled photogrammetrists to build virtual 3D models. Surveyors would survey on the ground the coordinates and heights of points visible on the models, so that they could be rotated and scaled to the national coordinate reference system. The advent of precise GPS (and latterly multi-constellation GNSS) and inertial motion sensors meant that less ground control was needed and digital photography enabled automated model generation with pixel matching software, but the technique has remained fundamentally unchanged.

Then, around the turn of the millennium, along came LiDAR as a practical alternative for producing digital ground models. This technology depended upon GPS and inertial sensors in the aircraft to determine the precise position and attitude of the plane. A laser scanner would scan the ground to produce a cloud of 3D points. Other than the 3D coordinates, there is little intelligence that can be gleaned from a LiDAR point, but it is possible to record observations to the first, intermediate and last points that the LiDAR hits on its way down from the plane. The first return might be from the tree canopy, the second could be from a tree trunk and the third could be from the ground. Using this, and sophisticated filtering algorithms, it is possible to produce a 'bare earth' digital terrain model. Under ideal conditions, the height accuracy can get down to a few centimetres and at a much lower cost than photogrammetry.

The Trimble Zx5 Multirotor: "Pilots must maintain direct unaided visual contact with the aircraft at all times..."

Fixed wing UAs

In recent years fixed-wing unmanned aircraft (UA) have been developed for taking aerial photography. They can easily be carried around in the boot of a car and launched and landed from small areas of open grassland.

When used for mapping, the enabling technological breakthrough is not the aircraft, but the software used to build the photogrammetric models. Innovative companies have produced software that can take a bundle of overlapping consumer-grade images and produce 3D models cheaply and largely automatically. The result is that it is no longer necessary to take the photography with a heavy, calibrated camera because UAs can carry small, mass-produced high-resolution cameras, such as you might find in a mobile phone. These are light and can be carried by light aircraft – most weigh less than a kilogram.

Camera calibration is treated as an unknown by the processing software - that is solved at the same time as the 3D model is built. But to do this requires photography with 80 to 90% overlap. The process depends upon redundant image data so, given the small amount of time needed to cover an area, it makes sense to fly it twice with the second set of flight lines perpendicular to the first. UAs carry rudimentary GPS positioning and MEMS inertial sensors. These observations also go into the mix as a means of letting the program know roughly where each image is located before the processing begins, as well as contributing to the georeferencing of the product.

Multicopters

Muilticopter UAs are ideal for inspection work because it is possible to control them so that they hover over the objects to be photographed. They are generally heavier than fixed-wing aircraft and can carry larger payloads. Using high-resolution cameras or video, they are regularly used for inspection work on oil rig facilities, power-line towers and other locations that may be inaccessible or dangerous. Helicopters have not generally been favoured for mapping because they have a shorter range but they do have the advantage of being able to carry a heavier payload. They can carry more sophisticated cameras and recent developments have seen helicopter UAs carrying other sensors, such as laser scanners and hyperspectral imagers.

The flight time (range) for multicopter UAs is currently around fifteen minutes. For mapping purposes this means coverage of around ten hectares in each flight. The range will no doubt increase as the technology develops. Because multicopters can be used for inspection work as well as mapping, they have access to a much larger market than fixed-wing UAs and it seems inevitable that they will dominate within a few years.

Flight regulations

Most aerial photography is carried out using small UAs with a weight, including payload of less than 20kg. Their operation is governed by Civil Aviation Authority (CAA) regulations in Britain, as covered in the neighbouring article. The UA operator must be trained in order to be legally able to perform 'aerial work'. Clients should request sight of the training certificate when commissioning surveys. However, It is a common misconception that UAs are banned from use in built-up

Regulations for Safety

UNMANNED AIRCRAFT, irrespective of their size, are still classified as Aircraft. The person in charge of operating the controls of an unmanned aircraft is referred to as the pilot. The Civil Aviation Authority (CAA) will not allow unmanned aircraft to present or create a greater hazard to anyone (or anything) than the equivalent operations of manned aviation. The CAA oversight of unmanned aircraft is based solely on safety considerations. It does not regulate any wider issues, such as privacy or nuisance.

Small unmanned aircraft (SUAs)

Unmanned aircraft, irrespective of their size, are still classified as Aircraft. The person in charge of operating the controls of an unmanned aircraft is referred to as the pilot. The Civil Aviation Authority (CAA) will not allow unmanned aircraft to present or create a greater hazard to anyone (or anything) than the equivalent operations of manned aviation. The CAA oversight of unmanned aircraft is based solely on safety considerations. It does not regulate any wider issues, such as privacy or nuisance.

Small unmanned aircraft (SUAs)

Aircraft of 20kg or less are classified as small unmanned aircraft. They do not require any specific CAA airworthiness certification but operators should remember that the pilot is at all times legally responsible for the safe operation of the aircraft. Anyone operating a small unmanned aircraft for aerial work (ie. for which he/she is receiving remuneration) requires permission to operate from the CAA.

Flying outside congested areas

Pilots must maintain direct unaided visual contact with the aircraft at all times; within the UK, such 'visual line of sight' operations are normally accepted to a maximum distance of 500m horizontally and 120m (400ft) vertically from the pilot. In this context, 'unaided' does permit the use of corrective spectacles. Flight beyond these distances can be permitted, but the operator is required to provide explicit proof that this can be conducted safely.

Some unmanned aircraft have a facility to provide the user with a video stream of the flight from an attached camera, which gives an impression of the flight from 'onboard' the aircraft. The video stream can be viewed on a handheld device such as a smartphone or special visors and goggles. It should be pointed out, however, that such 'first person views' are not considered suitable for collision avoidance purposes and hence the aircraft must still be visually observed by the pilot during its flight in order to comply with the law.

Flying in congested areas

Operators of small unmanned aircraft being used for surveillance or data acquisition which involves flying close to people or objects, require permission from the CAA, whether or not they are undertaking aerial work. Specifically, this means flight over or within 150 metres of any congested area, over or within 150 metres of an organised open-air assembly of more than 1,000 persons, or flight within 50 metres of any person, vessel, vehicle or structure that is not under the control of the pilot. 'Congested Area' means, in relation to a city, town or settlement, any area which is substantially used for residential, commercial, industrial or recreational purposes.

Flying in controlled airspace

If the flight is to be conducted within 'Controlled' Airspace, or within the Aerodrome Traffic Zone ATZ of an airfield (the dimensions of an airfield ATZs vary, but encompass the airspace within either a 2 or 2.5 nautical mile radius of the airfield) permission to fly an aircraft with a mass of more than 7kg must be obtained from the Air Traffic Control (ATC) unit/authority and the flight must be operated in accordance with that permission and any additional restrictions required by ATC.

To obtain an operating permission, an operator has to prove a sufficient level of competence and an understanding of the safety implications – the CAA will ask to see an up-to-date operations manual for the requested activities and evidence that the pilot is sufficiently competent. A risk assessment / method statement will be required for the flight concerned. These requirements are aimed at the protection of people and property which are not involved in the activity and are considered proportionate to the scale of activity taking place.

With regard to pilot qualifications, in order to grant a permission, the CAA would need some proof of the pilot's overall airmanship skills and awareness and his/her ability to operate the aircraft safely. This is not a 'Civil Pilots Licence', but it is an independent assessment of an individual's knowledge and operating capabilities. Two companies currently perform this assessment on behalf of the CAA:

- EuroUSC (**www.eurousc.com**) – their assessment is called the Basic national UAS certificate (BNUC-S)
- Resource UAS (**www.resource-uas.co.uk**) – their assessment is called the 'Remote Pilot Qualification-Small (RPQ-S)

CAA permission is not necessarily required for each individual flight, but the details of what is and is not permitted will be listed on each individual operator's permission.

UAs between 20kg and 150kg

Larger unmanned aircraft are required to comply with the full requirements of the Air Navigation Order under UK regulations in the same way as any other manned aircraft operation. This includes the requirement for a Certificate of Airworthiness, a properly licensed pilot, the ability to comply with the rules of the air etc. However, the CAA may be prepared to exempt an aircraft operation from some of these requirements if a suitable safety case can be offered in respect of the level of airworthiness assurance and the intended flights. The CAA may issue an exemption on the basis of its own investigations or by recommendation from an organisation approved under BCAR A8-22. Currently only one organisation has received such approval.

Larger unmanned aircraft which need to be flown at extended ranges from their pilot are currently being tested for military and civilian applications. The airworthiness requirements for these larger unmanned aircraft are equally as stringent as those required for the equivalent manned aircraft. To ensure safety, these tests are flown in 'segregated' airspace, which is essentially closed to other aircraft.

If large unmanned aircraft are to be allowed to operate in 'non-segregated' airspace (in the presence of other aircraft), a 'detect and avoid' capability, which replicates a traditional pilot's ability to look out of the aircraft, will be required. This technology will be necessary for unmanned aircraft to safely integrate in shared airspace with manned aircraft, such as light aircraft and fast military jets. Until unmanned aircraft have the ability to intuitively avoid other airspace users, in the same way as manned aircraft should, then they will not be allowed to operate outside of 'segregated' airspace.

The Regulations relating to all flying operations within the UK are contained within CAP393 Air Navigation: The Order and the Regulations (ANO 2009). Additional requirements for UAs are published in CAP722.

For more information, visit **www.caa.co.uk/cap393, www.caa.co.uk/cap722 and www.caa.co.uk/uas**

areas. Flights are allowed in these 'congested areas', but the operator has to obtain permission from the CAA for each flight.

Whilst on the subject of safety, it is good practice for operators to keep a log of all flights and record all incidents. It is important for the industry that crashes are recorded so as to learn from mistakes, and inform risk assessments. Feedback should be sent to the relevant parties – such as the UA manufacturer. Clients should request this information before engaging the operator.

UAs - a new market

Photogrammetry from UA aerial photography does not replace traditional photogrammetry of large areas, but makes remote sensing of suitable smaller sites a practical and economic alternative (or supplement) to ground-based surveying. Georeferencing that relies on the observations from the navigation-grade sensor on the UA will only be accurate to a metre of two in plan and worse in height. Clients should beware, because it is possible to generate photogrammetric models using navigation grade GPS data. The models will appear accurate to the untrained eye.

For higher accuracy, down to around 30mm in height, the surveyor has two options. Firstly, he can observe ground control points. These are 3D coordinated points, typically markings on a flat surface, such as parking bay lines on tarmac, but in practice it is difficult to find points on flat ground that are well defined in plan, so most surveys will be controlled using pre-marks. These should be of a size and colour (which should be matt) that can be easily identified on the photography. Shiny objects that cause glare tend to confuse the pixel matching process and result in blurring. Alternatively, some UAs now have the capability of recording camera exposure positions to high accuracy using GPS real time kinematic methods. Using the latter technique no ground control points are needed, but the surveyor should avoid the risk of system errors by proving his methodology using ground control points.

UA aerial photography can be used to produce a digital surface model. This is not a bare earth model because only the objects in the image can be modelled. Unlike LiDAR, the ground level will only be recorded if it can be seen on the imagery. If the supplier is offering a bare earth model, it is worth investigating the quality of the filtering algorithms that he proposes to use.

For this reason UA photography has been very popular for surveying un-vegetated surfaces such as quarries. The technique is also useful for surveying other hazardous sites, such as waste tips where there are issues with safety for surveyors working on or in gaining access to the site.

Orthoimagery is produced by draping the images over the surface model to give a single georeferenced photo-realistic image. Orthoimages can be valuable for recording the surface features for record purposes and regular flights can be a useful and economic means of recording progress on development sites.

Clients should request sight of the training certificate when commissioning surveys.

Wind

UAs are affected by wind in two ways. Firstly if the wind is too strong the aircraft motor might not be able to gain ground when flying into the wind. Secondly, turbulence can cause blurring of the images and also result in overlaps that are either larger or smaller than planned. This effect will be less significant on larger aircraft. It is worth bearing in mind that flying is weather dependent and that contractors located close to the site will be better able to make use of good weather windows.

Wind also affects the take-off and landing. Fixed-wing UAs land on their belly with the result that the fuselage has a limited lifespan before needing replacement. Naturally, the harder the

***Above**: Aircraft inspection – an unusual application for an Aibotix UAV which featured on the front cover of the March/April issue of Geomatics World.*

landing the more wear and tear on the aircraft body. This can be a significant cost. This is not a problem with multicopters.

Privacy

As a final point, operators should take careful note that the collection of images of identifiable individuals, even inadvertently, when using cameras mounted on a small unmanned surveillance aircraft, will be subject to the Data Protection Act in the UK. This Act contains requirements concerning the collection, storage and use of such images.

• *Acknowledgement: Thanks to Gerry Corbett, CAA, for his comments on this article.*

Introduction to UAV Suppliers & Developers

Let's be clear. UAVs are platforms for sensors. Some are supplied fully integrated, like Trimble's UX5 HP, senseFly's eXom or Riegl's RiCopter, which carries a LiDAR sensor or is offered as the "BathyCopter" configured to look through the water column, but the majority can be supplied by their manufacturers with or without a sensor, allowing users to create their own system for which an increasing number of companies offer a range of sensors from laser scanning, imaging, GNSS to INS.

Unsurprisingly, we've found more models this year for our annual review. A word or two about the entries. First, all seem to be powered by rechargeable Lithium polymer batteries so perhaps there no point in highlighting this in future unless new power sources emerge like the Wankel engine favoured for some military applications or hydrogen fuel cells in the early stages of development.

You need to be wary about flight duration times. The maximum times quoted (the best is 50 minutes) mean that if line of sight is to be maintained by the controller the effective duration is half that quoted so that craft can return to their launch site.

Few suppliers will quote cost, preferring to remain cagey until a client's application has been assessed and exactly which sensors are needed. We are also in a rapidly developing market with new players emerging, so expect competition to drive prices down. Nevertheless, a UAV with a high-resolution imaging sensor or multi-spectral system is likely to cost as least as much as a high end total station.

While there are many more UAVs in the market than those we've listed, we believe that those in our tables are the ones most likely to be suitable for use by surveyors and engineers for mapping and inspection. **Full listings begin page 22.**

Image				
MANUFACTURER	Aibotix GmbH	Aeronavics Ltd (former Droidworx)	Aeronavics Ltd (former Droidworx)	Aeronavics Ltd (former Droidworx)
Model	**X6**	**BOT Ti-QR**	**XM-6 Ti-QR**	**SkyJib** (several models)
Type	Hexacopter	MultiRotor	MultiRotor	MultiRotor
Cost (approx)	< €33,000 depending on configuration	Bind 'N Fly: NZ$ 5,999 Ready To Fly: NZ$ 8,075 Ready To Operate: NZ$ 11,950	Bind 'N Fly: NZ$ 8,999 Ready To Fly: NZ$ 11,075 Ready To Operate: NZ$ 14,950	Bind 'N Fly: NZ$ 13,995 Ready to fly: NZ$ 16,585 Ready to pperate: NZ$ 23,475
Primary app	Inspection, Mapping, Surveying	advertising/inspection/mapping/ surveillance	advertising/inspection/mapping/ surveillance	filming/inspection/mapping/ surveillance
Weight less sensor	3.4 kg	5.0 kg	4 kg	8 – 11 kg
Payload	2.0 kg	1.2 kg	2 kg	2.5 – 7.5 kg
Launch method	Autonomous vertical take off	Autonomous vertical take off	Autonomous vertical take off	Autonomous vertical take off
Landing method	Autonomous vertical landing	Autonomous vertical landing	Autonomous vertical landing	Autonomous vertical landing
Wingspan (mm)	1050 m	631mm Diameter	794mm Diameter	912 – 1172mm Diameter
Size of carrying case (cm)	103 × 110 × 43 cms	80.2 × 52.0 × 31.6 cms	83.8 × 38.1 × 35.6 cms	varies for each model
Avg. flights before new body	Not necessary	300 hours	300 hours	300 hours
Cost of new body	–	Approximately Bind 'N Fly cost	Approximately Bind 'N Fly cost	Approximately Bind 'N Fly cost
Max operating speed (km/h)	40 km/h	80 km/h	80 km/h	80 km/h
Max wind speed for flying (km/h)	36 km/h	30 km/h auto - < 60 km/h manual	30 km/h auto - < 60 km/h manual	30 km/h auto - < 60 km/h manual
Power source (battery type)	Lithium-polymer 5,000 – 10,000 mA, rech.	Lithium-polymer	Lithium-polymer	Lithium-polymer
Max flight duration	30 min	40 mins	25 mins	15 - 20 mins
Camera with UAV (make, model and MPx)	None. Recommended: Nikon D800 for hi-res inspections. Nikon Coolpix A or Sony Alpha 7R for hi-res mapping.	-	-	-
Can other cameras be deployed?	Yes. Canon, Olympus, Nikon, Sony, GoPro and others.	Yes	Yes	Yes
Other sensors available:	Infrared, Multispectral	Laser scanner, infrared - any sensor within payload	Laser scanner, infrared - any sensor within payload	Laser scanner, infrared - any sensor within payload
Recorded position of photo centres	Navigation-grade DGPS	Depending on camera - eg navigation-grade GPS / precise GPS / not recorded	Depending on camera - eg navigation-grade GPS / precise GPS / not recorded	Depending on camera - eg navigation-grade GPS / precise GPS / not recorded
Recorded aircraft tilts for each photo	Not necessary.	eg MEMS / not recorded	eg MEMS / not recorded	eg MEMS / not recorded
Flight planning & control software	AiproFlight flight planning s'ware	Supplied with the UAV	Supplied with the UAV	Supplied with the UAV
Additional information (facts not covered elsewhere in table)	The Aibot X6 offers a high degree of robotics, is easy to fly or can execute a mission autonomously. Available with a variety of sensors.	The Aeronavics BOT is a compact industrial grade aerial robot designed for a wide variety of applications including agriculture, sports filming, journalists in the field, security and industrial uses. Fitted with 15-inch propellers and industrial motors.	Extensive R&D has been invested in the Functional Design and Cosmetic Appeal of the Aeronavics XM – Ti-QR Series, resulting in a practical yet beautiful and high-performance craft. The Quick Release easy pack down features in conjunction with advanced vibration dampening technology makes this craft the professional level option for those that are using Mirrorless DSLR's or HD camcorders and are looking for quality, versatility and beauty.	The SkyJibs are the Aeronavics' Signature Pro Camera Ships - purposefully and carefully designed to deliver an ultra-strong airframe package with maximum performance and reliable in-flight characteristics. The Ti-QR Series combines state-of-the-art aerospace and industrial grade materials and offers easy pack-down quick-release components as well as advanced vibration dampening technology.
Supplier name (or logo)				
Contact name	Mathias Motz			
Email	mathias.motz@leica-geosystems.com			
Telephone	+ 41797661362			

				Image
Draganflyer	MosaicMill/Videodrone	RIEGL Laser Measurement Systems GmbH	senseFly	MANUFACTURER
Commander	**Geodrone 4XL**	**RiCOPTER**	**eBee**	Model
MultiRotor	Quadcopter	MultiRotor / Octocopter	Fixed wing	Type
				Cost (approx)
mapping/public safety/agriculture	mapping, crop monitoring	surveying, mapping, agriculture & forestry, archaeology	Mapping (3D)	Primary app
2.75 kg	3.5 kg	8 kg	0.545 kg	Weight less sensor
1kg	e.g. 0.5 kg	16 kg (batteries + sensor)	130-150 g	Payload
Autonomous vertical take off	Vertical take off	Autonomous vertical take off	Hand launch	Launch method
Autonomous vertical landing	Vertical landing	Autonomous vertical landing	Very steep and precise autonomous landing	Landing method
873 mm	670 mm	1920 mm	960 mm	Wingspan (mm)
60 × 54 × 28 cms	75 cm × 75m × 30 cm	122 × 81 × 54 cms	0.55 × 0.25 × 0.45m (Fits IATA hand luggage regulation)	Size of carrying case (cm)
	not necessary	–	About 200 flights	Avg. flights before new body
	–	–	–	Cost of new body
50 km/h	40 km/h	60 km/h; cruise: 40 km/h	90 km/h	Max operating speed (km/h)
50km/h	36 km/h	30 km/h	45 km/h	Max wind speed for flying (km/h)
Lithium-polymer	Lithium-polymer	LiPo battery; 4 × 12.500 mAh	Lithium polymer battery	Power source (battery type)
45 mins	40 mins with payload	up to 30 mins	50 min	Max flight duration
Sony RX100 III/Sony QX100	Sony a6000, 24 Mpix, NDVI version for argiculture	Optional: Sony Alpha 6000, 24.3MPx	Sony WX, 18.2MPx	Camera with UAV (make, model and MPx)
Yes FLIR TAU 2, MicaSense RedEdge Multispectral, TetraCam ADC Micro Multispectral	Yes Thermal, hyperspectral sensors	Yes, customer integration Laser scanner: RIEGLULS-System; RIEGL VUX-SYS (RIEGL VUX-1UAV + INS-GNSS)	thermoMAP, Canon S110, etc Thermal near infrared (NIR)	Can other cameras be deployed? Other sensors available:
Navigation grade GPS	GNSS positions	precisely triggered and timestamped with INS-GNSS	Navigation-grade GPS	Recorded position of photo centres
	MEMS	Yes	Aircraft orientation is recorded in images.	Recorded aircraft tilts for each photo
Optional (Draganfly Surveyor)	Google based	Supplied with the UA	eMotion 2, included with UAV	Flight planning & control software
Draganfly Innovations Inc., the longest running manufacturer of multi-rotor helicopters in the world and the maker of the first civilian small unmanned aerial system to be credited with saving a life, designs Draganflyer helicopters. Draganfly shapes the aerial imaging and public safety revolution with its gyro-stabilized camera payload systems and digital video down-link technology.	Carbon-fibre construction, weather proof, full telemetry, bright LEDs, extremely stable flight, advanced camera stabilization MosaicMill	Octocopter with foldable carrier arms. Max. take-off mass 25 kg (payload up to 16 kg). IMU/GNSS control unit and optional cameras fully integrated. Survey grade measurement performance: 230° FOV, 350,000 meas./sec., 10 mm accuracy, Laser Class 1.	• Very steep and precise landing • 3D flight planning • Multiple drones operation • Collision avoidance • Easy data management • Automatic safety features • 3D image processing software	Additional information (facts not covered elsewhere in table)
Draganfly Innovations Inc.	www.mosaicmill.com/contact.html	Philipp Amon pamon@riegl.com +43 2982 4211		Supplier name (or logo) Contact name Email Telephone

Image				
MANUFACTURER	senseFly	senseFly	senseFly	Topcon
Model	**eBee Ag**	**eBee RTK**	**eXom**	**Falcon 8**
Type	Fixed wing	Fixed wing	Quadcopter	Octocopter
Cost (approx)				
Primary app	Crop monitoring	Survey-grade aerial mapping	Mapping and inspection	Inspection / mapping / surveying
Weight less sensor	0.545 kg	0.6 kg	1.8 kg (inc. payload)	1.1 kg
Payload	130-150 g	130-150 g	–	0.8 kg
Launch method	Hand launch	Hand launch	Automated take-off	Vertical take-off
Landing method	Very steep and precise autonomous landing	Very steep and precise autonomous landing	Automated landing	Vertical landing
Wingspan (mm)	960 mm	960 mm	56 × 80 × 17 cm	800 mm
Size of carrying case (cm)	0.55 × 0.25 × 0.45m (Fits IATA hand luggage regulation)	0.55 × 0.25 × 0.45m (Fits IATA hand luggage regulation)	92 × 64 × 22cm	1m × 1m × 0.4m Backpack, 1m × 0.7m × 0.15m
Avg. flights before new body	About 200 flights	About 200 flights		Not required
Cost of new body	–	–		–
Max operating speed (km/h)	90 km/h	90 km/h	12 m/s (43.2km/h)	55 km/h
Max wind speed for flying (km/h)	45 km/h	45 km/h	10 m/s (36 km/h)	50 km/h
Power source (battery type)	Lithium-polymer	Lithium-polymer	Lithium-polymer	Lithium-polymer
Max flight duration	45min	45min	Up to 22min	22 mins
Camera with UAV (make, model and MPx)	Canon S110 NIR, 12 MPx	Sony WX, 18.2 MPx	Triple View Head (38 MPx mechanical shutter, thermal, HD video)	Sony Alpha 7R, 36 Mpx
Can other cameras be deployed?	Canon S110 RE, S110 RGB, multiSPEC 4C, thermoMAP	Canon S110 RGB, S110 RE, S110 NIR	No	Yes
Other sensors available:	Multi spectral, red edge	Thermal, Near infrared (NIR)	–	Panasonic Lumix TZ71 + FLIR TAU 640 Sony Camcorder HDR-PJ810E
Recorded position of photo centres	Navigation-grade GPS	Navigation-grade GPS	Navigation-grade GPS	Navigation-grade GPS
Recorded aircraft tilts for each photo	Aircraft orientation recorded in images.	Aircraft orientation recorded in images.	Aircraft and gimbal orientation recorded in images.	MEMS
Flight planning & control software	eMotion 2, included with the UAV	eMotion 2, included with the UAV	eMotion X, included with UAV	AscTec Navigator & onboard flight planning
Additional information (facts not covered elsewhere in table)	Precision agriculture: • Plant stress assessment • Chlorophyll indication • Tree classification • Biomass indication • Nitrogen recommendation • Growth monitoring etc	Get absolute accuracy down to 3cm - without Ground Control Points	Sensor-rich drone for professionals, offering TripleView imaging and advanced situational awareness.	- Fully adaptive flight control & redundant propulsion system - Triple redundant electronics (Trinity) - No sensor initialization required
Supplier name (or logo)				
Contact name				
Email				
Telephone				

				Image
Topcon	Trimble	Trimble	Trimble	MANUFACTURER
Sirius Pro	**UX5**	**UX5 HP**	**ZX5**	Model
Fixed wing	Fixed wing	Fixed wing	Multirotor	Type
				Cost (approx)
Hi-resolution data capture. Survey mapping, agriculture	Inspection / mapping / surveying	Inspection / mapping / surveying	Inspection / mapping / surveying	Primary app
Take-off 2.7 kg inc camera	2 kg	2 kg	2.7 kg	Weight less sensor
550g	0.2 kg	0.5 kg	2.3 kg	Payload
Hand launch	Launcher	Launcher	Vertical take off	Launch method
Fully automatic/autopilot supported/full manual belly landing	Glide belly landing	Glide belly landing	Vertical landing	Landing method
1630 mm	1000 mm	1000 mm	850 mm	Wingspan (mm)
119 × 40 × 44 cms	114 × 72 × 20 cms	114 × 72 × 20 cms	–	Size of carrying case (cm)
200-300	Varies	Varies	Varies	Avg. flights before new body
–			–	Cost of new body
120 km/h, cruise speed 65 km/h	110 km/h	110 km/h		Max operating speed (km/h)
50 km/h	65 km/h	65 km/h	35 km/h	Max wind speed for flying (km/h)
Lithium-polymer	Lithium-polymer	Lithium-polymer	Lithium-polymer	Power source (battery type)
45 mins	50 min	40 min	20 min	Max flight duration
Panasonic GX1. 16 MPx	Sony A5100 24 MPx	Sony a7R 36 MPx	Olympus E-PL5 16 MPx	Camera with UAV (make, model and MPx)
Yes (NIR)	No	No	Yes	Can other cameras be deployed?
NIR	None	None	No	Other sensors available:
RTK GPS	Navigation-grade GPS	Precision GNSS	Navigation-grade GPS	Recorded position of photo centres
MEMS	Yes	Yes	Yes	Recorded aircraft tilts for each photo
MAVinci Desktop	Trimble Aerial Imaging	Trimble Aerial Imaging	GroundStation	Flight planning & control software
				Additional information (facts not covered elsewhere in table)
	KOREC / Survey Solution Scotland	KOREC / Survey Solution Scotland	KOREC / Survey Solution Scotland	Supplier name (or logo)
				Contact name
				Email
				Telephone

Caintech reaches new heights

Global positioning partner for geo-businesses Topcon, has helped Caintech Ltd. increase surveying accuracy and safety in the Scottish mountains following the purchase of a Sirius Pro UAV.

For the Inverness-based surveying company Caintech, acquiring an unmanned aircraft system (UAS) has allowed them to diversify their business offering – from the scale and complexity of projects they are involved in, to the industries in which they operate.

Established in 1989, Caintech was initially involved with quantity surveying but for the past nine years has shifted to being predominately land surveying, carrying out topographic, bathymetric and laser-scan surveys. In 2014, the firm decided to expand its capabilities so that it could undertake more detailed surveys over wider areas. **Tim Riome**, chief pilot at Caintech, was responsible for choosing a suitable aerial mapping system for the firm and, with an aviation background, had strict requirements for a robust and reliable vehicle.

"Our surveying teams were using terrestrial laser scanning and photogrammetry to image capture across some of the UK's most remote locations," said Riome. "Information was gathered from multiple set-ups and merged into a single dataset during processing. This required pre-surveyed ground control points, which restricted the areas we could cover."

The harsh conditions of the Scottish Highlands were a key issue for the company's survey teams, often casting limitations on the scale of their work. Teams were spending weeks in the field, working across tough terrain and in extreme weather.

"We needed a solution that was durable enough to overcome the limitations of the hostile environment, while decreasing the time the team spent on the ground," continues Riome.

Caintech chose the Sirius Pro aerial mapping system from Topcon as it can create aerial maps and digital terrain models, while being fully operational in constant wind speeds up to 50kmph, gusts up to 65kmph and even in the rain. The UAS surveys to a high degree of accuracy across demanding areas, while its built-in navigation system (RTK GPS) eliminates the need for ground control points, making it ideal for challenging projects.

"From an aviation point of view, we found that the Sirius Pro was the most robust system out there, offering the most stable and steady platform with high quality imagery, zero vibration and steady landing," said Riome.

One of the firm's most notable surveys using the UAS has been for a new cable track over a Scottish mountain at elevations over 860m. Jim Main, managing director at Caintech, explains: "It required the UAS to travel at an altitude of around 1km above sea level to survey the mountainous regions. With the Sirius Pro, we can now take on all the projects we are approached to undertake and can offer competitive prices as we have the technology and, therefore, the capacity". Since acquiring the UAS, Caintech has widened their business' offering to include wind farms, power lines and quarries – all of which cover vast areas.

With the UAS technology, concludes Riome, "we no longer need to expose our staff for long periods of time to hostile and possibly dangerous locations. Large projects which previously demanded two or three survey teams working on site for a few weeks now require just one operator in the field for a maximum of four to five days. Not only has it led to huge safety benefits for our staff, but it has improved cost and time efficiencies too. As the business continues to expand exponentially. We are looking to purchase more Sirius Pro's and to recruit more operators."

• *For more information on the UAS, please visit the Topcon website:* **http://global.topcon.com/**

***Right**: a surveyor prepares the Sirius Pro for launch from a remote location. Note the low-ground pressure vehicle.*

UAV MAPPING SERVICE SUPPLIERS

Company name	Atkins Ltd	Azimuth Land Surveys Ltd	Future Aerial Innovations	Geodime Ltd	Remote Aerial Surveys	Resource Group	UAV Surveys
Contact name	Charlton Bland	Neil Fowler	Andrew Blogg	Myfanwy Fisher	James Dunthorne	Mark Jones	John Phillips
Contact email address	Charlton.Bland@atkinsglobal.com	enquiries@azimuthgroup.co.uk	andrew@futureaerial.com	info@geodime.co.uk	james.dunthorne@remoteaerialsurveys.co.uk	uas@resourcegroup.co.uk	john@uavsurveys.co.uk
Contact telephone number	01454 662 906	01633 263575	07919898259	01903 741035	01444 401 840	+44 (0) 1633 835 123	7902925230
Base location	Bristol	Cardiff	Bristol	West Sussex	Gatwick, Crawley	Cwmbran, South Wales	Chelmsford
Member of The Survey Association?	Yes	Yes	No	No	No	No	No but regulated by the RICS
Number of qualified UA pilots	3 through partnership	10 combined 30 years experience	2	2	3 + 2 more in training	10	1
Highest qualification of permanent staff?	MRICS, MCInstCES	MSc	MSc	MSc	James Dunthorne - PhD (finalist in Collision Avoidance for UAVs)	Our Pilots have 30 years + UAS experience, All holding RPQs	FRICS / BNUC-S
List of UAs operated	Custom rotary wing and fixed wing	DJI Inspire 1, DJIs800 EVO, Ascending Technologies Falcon 8, Hawkeye Lancaster Fixed Wing, Huginn X1	Ebee, Quest, DJI Phantom, Cinestar 8 and Falcon x8	Aibotix, Inspire,	Octirotor, 2 x Hexrotors, 2 x Quadrotors, Fixed Wing	Ascending Technologies Falcon 8, DJI s800 EVO & Inspire 1, Hawkeye Lancaster Fixed Wing, Huginn X1	MultiRotor G4 Surveying Robot
Date started UA mapping	2015	Jan-14	2011	2014	Jun-13	Jan-14	Apr-15
Inspection services offered?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Orthophotography and DSM service?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DTM service offered?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other UA services offered?	Geodetic control survey, topographic mapping, (DEM/DSM/DTM), volume calculations, multispectral and NIR imagery, aerial inspection, video and the full suite of GIS and visualisation services including virtual reality.	Aerial photography & filming, panoramic images, 3D modelling, terrestrial laser scanning	Preofessional Filming	Flythoughs, Photography and Video, Thermal and Multispectral Imaging and Inspections. Conversion and manipulation of UAV derived data for everything from Quarry Volumes to agricultural machine upload. Environmental monitoring.	UAV LIDAR, 3D building modelling, CAD, topo surveys, NIR mapping, Roof and building surveys, thermal surveys, as-built surveys, Volumetric analysis, Overland flow analysis, Watershed analysis, Contours, Flow accumulation, Cross sections, Flooding extent mapping	High quality Aerial Photography & Filming. Close visual aerial inspection. Thermal inspection imagery.	see Additional information
Full survey report provided?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Additional information (relevant facts not included elsewhere in the table)	Atkins' geomatics team has over 25 years of experience in aerial survey utilising both LiDAR and Photogrammetric sensors on various platforms for a wide variety of applications. The team has a combined experience of over 100 years in photogrammetry and geospatial data production which is overseen by our experienced Chartered Surveyors.	UK CAA Congested Areas Permission to operate to 5m of structures & buildings and Extended Line of Sight to 1km	FAi are amongst the most experienced UAV pilots in the UK, working on large scale projects across the UK, Europe and Africa.	Geodime is using high specification UAVs equipped with cutting edge sensors in conjunction with conventional survey technology to deliver a large range of geospatial products across a number of industry sectors. This is complementing our strong reputation in the Mining Industry across Europe	RAS is one of the 4 companies on Network Rail's UAV framework.Other customers include the Environment Agency, Severn Trent, Yorkshire Water, Local Councils, Engineering companies and Land Survey companies,	Resource Group has Congested Areas Operating Safety Case Permission for Aerial Work by the CAA, allowing us to: fly within 10m of the general public.; fly to within 5m of structures, buildings and unoccupied vehicles; Operate under these rules anywhere across the UK. Extended Visual Line of Sight (up to 1000m) CAA Permissions for Aerial Work; National qualified entity (SUA)	RICS Chartered Land Surveyors specialising in UAV airborne solutions including: DTM earthworks analysis, coastal erosion and accretion monitoring, topographic mapping, utility, energy and environmental surveys

Monitoring and preserving Henry VIII's warship, the Mary Rose

The iconic Tudor Warship the *Mary Rose*, which foundered nearly 500 years ago, is being lovingly preserved for future generations. The techniques being used include continuous monitoring using the latest total station and laser-scanning instruments as part of a Leica GeoMoS system.

STEEPED IN HISTORY, the *Mary Rose* was King Henry VIII's Tudor warship. Built between 1509 - 1511, the *Mary Rose* was a successful warship and in Henry VIII's possession for over 34 years, nearly the entirety of his reign. Adapting with the naval demands of the time, she started out as a troop ship and ended as a gun ship. During Henry's reign she fought in three wars: starting in battle in the first French War between 1512 and 1514 and ending in the third French War in 1545, her final battle.

The catastrophic sinking of the *Mary Rose* on the 19th July 1545 in front of the King has been a tale often retold. The cause of the tragedy is still uncertain; some accounts say French gunfire, a gust of wind or an unruly crew. Whatever the cause, the *Mary Rose*'s history and her supreme marine excavation have captured the imagination of the general public for generations.

Mary Rose's excavation

The discovery and excavation of the Tudor warship some 437 years after she sank was a milestone in maritime archaeology. Rediscovered in 1971 and salvaged in 1982 after years of hard work, the *Mary Rose* was brought back to Number 3 Dry Dock in Portsmouth's Naval Base, metres away from where she was lovingly built all those years ago. The silt on the seabed helped to preserve some 19,000 artefacts; each excavated and brought to the surface.

Brought back to Portsmouth, a secure and sheltered building was constructed over the ship so the process of conservation could begin. On October 11th 1983, the *Mary Rose* was open to visitors.

To stop the timbers from drying out and to inhibit fungal and bacterial growth, it was imperative to keep her wet. This was done by spraying the ship with chilled water. The ship also needed to be strengthened before the hull could be dried to avoid collapsing. The ship was next sprayed with a chemical called Polyethylene Glycol (PEG), which is like a wax. To properly conserve her the concentration of the PEG was gradually built up to avoid damage to the wood over a period of almost 20 years.

A new museum and advanced preservation techniques

By 2005 plans were being developed to create a new flagship museum in Portsmouth Historic Dockyard in which to house the ship's hull and her unique collection of artefacts, and to tell the story of her crew. These plans were realised when the new Mary Rose Museum opened in May 2013. Prior to opening, the wax spray was turned off and the drying process began, keeping the *Mary Rose* in an environmentally controlled environment, called the "hotbox", with a 54% relative humidity and temperature of 19 degrees Celsius. Once dried, the PEG will stop the timber's cells from collapsing and will hopefully help to preserve the ship for hundreds of years to come.

Enter Leica Geosystems

In 2013, Leica Geosystems was asked to assist with the conservation project and help to monitor the ongoing drying process of the ship in the confines of its "hotbox" within the new museum. The system adopted provides vital data to enable the Trust's conservation team to understand the effects of the controlled drying process on the 500-year old timbers and will be involved in the project for four years, after which time, the majority of the timbers will be dry. As the timbers dry, they can move and understanding the magnitude of this movement and in which direction is significant to this unique scientific research.

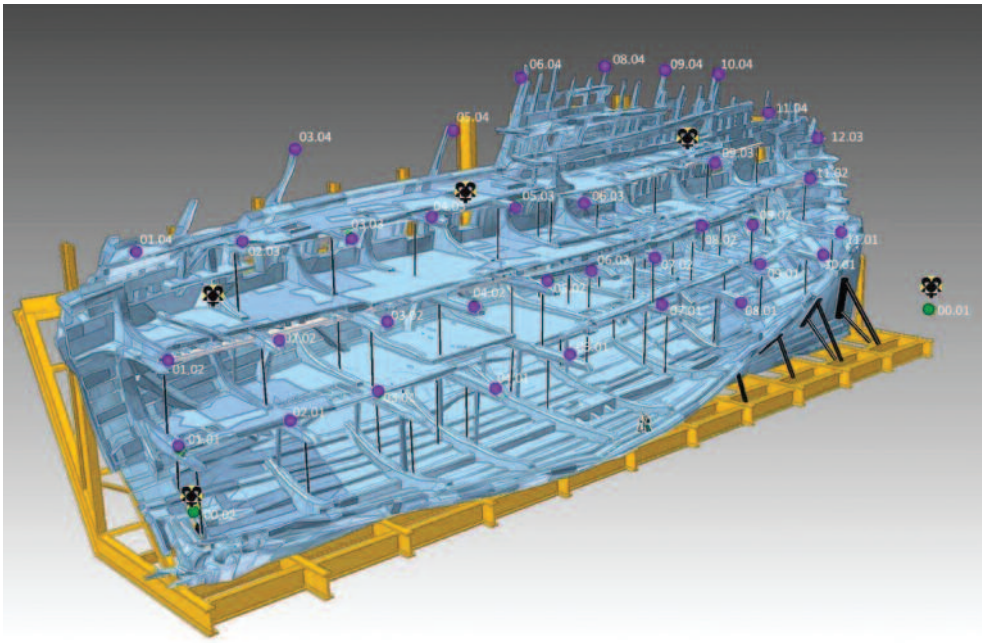


***Figure one** – locations of stable control reference points and discrete monitoring points.*

***Above**: a clear view of the Mary Rose's hull was essential for the Leica MS50 total station to be able to monitor the position of the 36 reflector targets attached to the ship's timbers.*

Once dried, all the black ventilation tubes aiding the drying process will be removed from around the timbers, opening up unhindered views. The ship is also supported with scaffolding and braces to provide extra support and protection and to slow down the movement of the ship, preventing both damage to this unique historical artefact and also safety-of-life for those working on the 500-year old timbers.

To accurately measure the hull's movement, a Leica MS50 total station was initially installed with optimal line-of-sight coverage onto the hull along with 36 reflector targets attached to the timbers in key locations (see figure one). The total station automatically calculates its position and orientation prior to each measurement cycle to guard against any movement of its position. Five widely distributed control reference targets mounted in stable locations away from the timbers form the basis of the resections. Measurement cycles run three times a day.

Unique project

With more than twenty-five years of automated monitoring expertise, Leica Geosystems has supplied the hardware, software and consultancy for this prestigious project. Involved from the early stages of the drying phase, account manager, **Mark Francis** commented: "Leica Geosystems is proud to be involved in offering the latest state-of-the-art measurement solutions to assist in the research of such a prestigious and unique project and we look forward to further collaborations."

In May 2015, Leica Geosystems' **Steven Ramsey** and Mark Francis also assisted with a High Definition Survey (HDS) using the newly released, state-of-the-art ScanStation P40 3D laser scanner to produce a point cloud of billions of points to accurately model the geometry of the structure, far beyond the thirty-six discrete monitoring points. The intention is to re-laser scan in 2016, post construction of the opened viewing galleries for an updated model.

Reliable system architecture

As with any continuous monitoring project, in addition to the sensors, power and communication are key components of the system architecture for the reliability and success of the complete solution. At the Mary Rose Museum, mains power and an ethernet cable connected to the site's LAN ensured continuous operation, control and data transfer with a computer in the museum connected to the network server. Leica Geosystems' GeoMoS monitoring software controls the measurement cycles three times a day. Additionally, the data is extracted to a spreadsheet format from the open SQL database and automatically emailed to key stakeholders on a regular basis for continued analysis.

"The incorporation of the Leica total station into our conservation plan provides us with invaluable information which will greatly enhance our understanding of the drying hull. This will allow us to develop a strategy which will ensure the future of this unique piece of cultural heritage", adds Dr **Eleanor Schofield**, conservation manager.

The data from the total station is delivered by email to PhD student, **Eleonora Piva** from the University of Portsmouth's Civil Engineering and Surveying Department. Eleonora is able to analyse the movement data, identifying trends and correlating to other lines of research including the dryness of the timbers.

Future of the Mary Rose

Since the introduction of the MS50 to the museum, there has been a lot more interest in how a total station works and in Leica Geosystems as a company, with visitors young and old alike wanting to understand more. Leica Geosystems works closely in partnership with the Mary Rose Trust, to not only monitor the ship's movement but to help support this important conservation and maritime archaeological project.

The Mary Rose Museum is entering a period of closure later in 2015 in order for the next chapter in her long and remarkable history to commence. Phase Two of the Mary Rose Museum will greatly improve the visitor experience by providing uninterrupted views of the ship from the walkways, as well as all the main galleries at all three levels. During this phase, movement monitoring of the 500-year old timbers will be critical and so the Leica total station will maintain its position in the next phase, continuing to provide vital data for the Mary Rose team. The Museum will remain closed to visitors for some eight months.

Acknowledgements

Leica Geosystems wish to thank for their contributions the staff of the Mary Rose Museum, in particular Dr Eleanor Schofield, conservation manager, Eleonora Piva, PhD student from University of Portsmouth and Dr David Begg, senior lecturer, University of Portsmouth's School of Civil Engineering and Surveying

To find out more about the Mary Rose Museum please visit: www.maryrose.org/

About the authors

Natalie Binder is marketing and communications manager, Mark Francis is local account manager; Marco DiMauro is monitoring specialist and Steven Ramsey, HDS technical manager. All work for Leica Geosystems Ltd, UK.

• *To find out more about Leica Geosystems please visit:* **www.leica-geosystems.com**

Welcome to our feature on Software for Geomatics. All the companies listed produce relevant software for geomatics applications and are listed following our invitation for details. 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

Cadcorp is a British software development company focused on geographic information system (GIS) and web mapping software. It offers a complete suite of products - the **Cadcorp Spatial Information System®** (Cadcorp SIS®) - addressing all phases of spatial information management.

Cadcorp SIS is well-suited to addressing one of the major challenges facing the geomatics sector: how to integrate the use of CAD and GIS. Both domains deal with spatial data, yet they 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. The result is that CAD and GIS usually differ in terms of data models, data formats, coordinate systems, and attribution levels.

Cadcorp addresses this conundrum by providing unsurpassed capabilities to share spatial data between the two domains, offering both file- and server-based sharing of spatial data.

Cadcorp SIS can read over 160 different CAD and GIS file, database and image formats natively without translation. We also include an easy-to-use DXF Exporter tool in our desktop software 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.

You can explore the spatial data-sharing capabilities of Cadcorp software by downloading Map Express - Cadcorp's free-to-use GIS.

http://www.cadcorp.com/products/free-mapping-software

Contact:
Cadcorp, Sterling Court, Norton Road, Stevenage, Herts. SG1 2JY
t: +44 (0) 1438 747996
f: +44 (0) 1438 747997
e: **richard.spooner@cadcorp.com**
w: **www.cadcorp.com**

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
Leica Geosystems, Hexagon House, Michigan Drive, Tongwell, Milton Keynes, MK15 8HT
t: +44 (0) 01908 513400
w: **http://www.leica-geosystems.co.uk** *or* **myWorld @ Leica Geosystems**

LSS

LSS is a land survey processing and DTM package from the UK 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. It will also import data in DXF, GENIO, CSV, LandXML etc.

There are three LSS products, LSS Solo, Vista and Elite. Users pay an annual licence fee which includes technical support and software updates. The software uses a USB dongle and can be installed on several computers and the dongle moved or shared across a network. Runs on Windows PCs and tablets (including Win10). Training courses are held once a month.

LSS Solo downloads/uploads to EDM and GPS equipment; produces a 3D contoured survey or building elevation with editing of levels, line styles, annotation and the addition of points via a set of quality-assured CAD-Pro commands. £250 a year.

LSS Vista includes Solo, plus Interface with Leica Nova MultiStation, as well as plan plotting, volumes between models, sections, design, even export to machine control systems (export the complete formation-level model) and more. £500 a year.

LSS Elite A comprehensive range of advanced volume options, isopachytes, plus slope and earthworks designs, restoration and topsoil stripping, tools for restoration models, line of sight and visibility analysis (ZVI and ZTV), rail survey overlap adjustment and gauge reporting. £750 a year.

LSS Point Clouds will read point cloud data in E57, LAS, LAZ, PTS or XYZ with or without Intensity and/or RGB. A software "Pipe" links the point cloud to the LSS DTM for rapid 3D digitising of line drawings, elevations and DTMs. £250 a year.

Education for teaching and non-commercial research use. £250 a year for a ten-user network system (including dongle) or £1,000 a year no limits and including Point Clouds.

PASSPORT for non-commercial collision investigation. The package includes the Elite system, Point Clouds and inclusive training tokens.

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.

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 64bit and 32bit 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 and tunnels: Cant and gauge checking, string overlap comparisons, formation adjustment, wriggle surveys, lift and slue computation, and integration with Amberg trolleys and scanlaser machine control. Compare tunnel differences and deformation and develop isopachytes from scans.

Rivers and water: Rapid processing of river surveys with output to EACSD / ISIS / HECRAS. 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 stations, scanners, 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 **sales@atlascomputers.ie** (Ireland)
t (UK): 01480 404888 **sccs@sccssurvey.co.uk** (SCCS, UK)
w: **www.atlascomputers.ie**

South Survey Ltd, official UK suppliers of Microsurvey Software

Over the last 30 years, MicroSurvey has developed a core set of software tools to help surveyors, civil engineers, construction layout professionals, and mapping specialists conquer their workflow challenges in the most efficient manner possible.

Offering one of the most complete survey design and mapping product lines in the industry, MicroSurvey covers software for the office as well as for the field; supporting hundreds of instruments and handheld devices. The staff values and listens to its customers, and MicroSurvey supports what it builds. Using a special "vote-based" system, development efforts for new features is largely determined by the numerous professionals using the software.

FieldGenius gives you a competitive advantage in the field. With code-free line work, smart points, and an updated stakeout interface and workflow, you will be amazed as to how much faster you can get the job done.

MicroSurvey CAD is a drafting program built specifically for surveyors. With a tiered approach to features, you can customize the exact feature level and price. Fully compatible with DWG files, MicroSurvey CAD gets you precisely what you need.Complete survey drafting, COGO, DTM, Traversing, Volumes, Contouring, point cloud manipulation and data collection interfacing are included.

STAR*NET 8 is latest version of the network adjustment program. An easy-to-use Windows package that adjusts 1D/2D/3D survey networks using rigorous Least Squares techniques. It handles networks containing conventional, level, and GPS observations with up to 10,000 adjustable stations. STAR*NET 8 now has a DBX converter available for all Leica users to input data straight into the program. For those who just need a DWG/DXF CAD program to import their surveys we offer GtarCAD 8.

Trial versions are available to download from our website.

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 Tuflow, 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.

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.

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, Unit 9-11 Mersey House, The Matchworks, Speke, Liverpool, L19 2PH
t: +44(0)845 450 4300
e: **info@topconsokkia.co.uk**
w: **www.topconpositioning.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 Embedded Handheld? 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

Contact:
Korec Group
t: 0845 603 1214
e: **info@korecgroup.com**
w: **www.korecgroup.com**
w: **www.trimble-terraflex.com**

Technical Services

Looking for a company with special experience? Check our chart for details of leading firms & page 31 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
APR Services Ltd	✓	✓	–	✓	✓	✓	–	✓	✓	✓	–	–	✓	✓	–	–	✓	–	–	✓	–	–	–	–	–	–
Aworth Land Surveys Ltd	✓	✓	✓	✓	✓	–	✓	✓	✓	✓	✓	–	✓	–	–	–	–	–	✓	–	–	–	–	–	–	–
Azimuth Land Surveys	✓	✓	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	✓	✓	–	✓	✓	–	✓	–	–	–	–
Geodime Ltd	✓	–	–	–	✓	–	–	–	–	–	–	✓	✓	–	–	✓	–	–	✓	✓	✓	✓	✓	–	–	–
Maltby Land Surveys Ltd	✓	✓	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–	–	–	✓	✓	–	–	–	–	–	–
NRG Surveys	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–	–	✓	–	✓	✓	–	–	–	✓	–	✓
Resource Group	✓	✓	✓	✓	✓	–	✓	✓	✓	–	✓	✓	✓	–	–	✓	–	✓	✓	✓	✓	✓	✓	–	–	–
The Scan Team Ltd	–	–	–	✓	✓	–	–	–	✓	–	–	–	–	✓	–	–	–	–	✓	✓	–	–	–	–	✓	–

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

Azimuth Land Surveys
28 Cardiff Road,
Newport,
NP20 2ED
Tel: 01633 263575
Fax: 01633 213767
e-mail: enquiries@azimuthgroup.co.uk
Contact: Neil Fowler

Geodime Ltd
Chanctonbury House,
Chanctonbury Walk,
Church Street,
Storrington,
West Sussex,
RH20 4LT
Tel: 01903 741035 Fax: 01903 741035
E: info@geodime.co.uk
Contact: Myfanwy Fisher

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

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

Resource Group Unmanned Aviation Services
Beacon House,
William Brown Close,
Llantarnam,
Cwmbran,
NP44 3AB
Tel: 01633 835123
e-mail: uas@resourcegroup.co.uk
Contact: Mark Jones

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

Classified Engineering surveying*showcase*2015

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**.

CLOSE RANGE LASER SCANNING

SURVEY SOFTWARE

SURVEYS

RECRUITMENT

Geospatial Surveyor

Location: Cumbria, Leeds or Southampton
Ref No: 10314

About WYG
We are an established international, award-winning consultancy operating in over 40 countries with a strong track record of providing creative solutions to some of the world's most challenging projects.

Intelligent consulting means creating strategies for success that are inspired by client needs and aspirations. Our creative and insightful consultants work in partnership with clients to identify, define and deliver innovative solutions to complex problems. We offer a range of skills across the WYG Group – surveying services & GIS, bridging design engineering, environment, project management, planning and socio economic needs.

We also take a proactive approach to putting people first within the process of sustainable development. We are committed to providing excellence and inspiring confidence in everything we do to satisfy the needs of our valued clients.

About the role
The Geospatial department are looking for a keen, progressive, versatile surveyor who can adopt a flexible approach to their role to provide support to our teams across the office as workload dictates. The individual will be willing to go the extra mile to ensure the quality data is delivered to meet the needs of our clients. The role will focus on, but not limited to, the following areas:

- Delivery against client specifications
- Quality assurance
- Project cost control
- Project programme
- Health & safety
- Personal learning & development
- Mentoring

About you
- A relevant technical degree is desirable, but not essential, together with a minimum of 12 months full time experience in the industry
- A good technical knowledge in the use of total stations, GPS & terrestrial laser scanners
- Experience in the use of relevant software including AutoCAD, Leica Geo Office, SCC, LSS, Cyclone, Cloudworx plus Microsoft Office
- The Applicant shall have a full UK driving license as the role will require travel around the country as part of their work related duties

Rewards
A rewarding future is yours at WYG. We're committed to supporting your professional aspirations – and with clear career paths and a wide range of opportunities, your goal will always be within reach. Our blended learning experience will help you develop all the skills and qualifications you need to succeed. Fantastic flexible benefits and personalised rewards make up an excellent package.

To apply visit https://apply.wygcareers.com/vacancies/geospatial-surveyor-222041.html

Survey Equipment Hire

The most comprehensive fleet in the UK

The hire of survey equipment has changed considerably over the years as a result of the demands made by design engineers and architects alike with buildings and infrastructure projects becoming increasingly more challenging. At SCCS we have recognised this trend and have the largest and most comprehensive hire fleet of survey and geospatial equipment in the UK. As the equipment has become more technically advanced with the advent of robotic total stations, kinematic scanning and wireless monitoring systems we have not forgotten it is service customers are looking for and we employ an unrivalled technical and logistical support team covering the UK to ensure you get the correct equipment where and when you need it.

Contact our dedicated hire team 01480 404888
or visit **www.sccssurvey.co.uk** for further details

Leica Geosystems

AMBERG TECHNOLOGIES

SCC SURVEY CONTROL CENTRE

www.sccssurvey.co.uk

SCCS THE SURVEY EQUIPMENT COMPANY